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A

SYSTEM OF ANATOMY

FOR THE USE OF

STUDENTS OF MEDICINE.

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WITH NOTES AND ADDITIONS.

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SYSTEM OF ANATOMY.

PART V.

OF THE NOSE: THE MOUTH: AND THE THROAT.

CHAPTER I.

OF THE NOSE.

The prominent part of the face, to which the word *nose* is exclusively applied in ordinary language, is the anterior covering of two cavities which contain the organ of smelling.

These cavities are formed principally by the upper maxillary and palate bones; and, therefore, to acquire a complete idea of them, it is necessary to study these bones, as well as the os ethmoides, the vomer, and the ossa spongiosa inferiora, which are likewise concerned in their formation.

In addition to the description of these bones, in the account of the bones of the head, it will be useful to study the description of the cavities of the nose which follows it. See vol. i. page 72.

After thus acquiring a knowledge of the bony structure, the student will be prepared for a description of the softer parts.

SECTION I.

Of the External Nose.

The superior part of the nose is formed by the ossa nasi, and the nasal processes of the upper maxillary bones, which have been already described; (see vol. i. pages 50—54,) but the inferior part, which is composed principally of cartilages, is much more complex in its structure.

The orifice, formed by the upper maxillary and nasal bones, is divided by a cartilaginous plate, which is the anterior and inferior part of the septum, or partition between the two cavities of the nose. The anterior edge of this plate projects beyond the orifice in the bones, and continues in the direction of the suture between the ossa nasi. This edge forms an angle with the lower edge of the same cartilage, which continues from it in a horizontal direction, until it reaches the lower part of the orifice of the nose, at the junction of the palatine processes of the upper maxillary bones; where a bony prominence is formed, to which it is firmly united. The upper part of the anterior edge of this cartilage, which is in contact with the ossa nasi, is flat, and is continued into two lateral portions that are extended from it one on each side, and form a part of the nose: these lateral portions are sometimes spoken of as distinct cartilages; but they are really continuations of the middle portion or septum.

Below the lower edge of these lateral portions are situated the cartilages which form the orifices of the nose, or the nostrils. Of these, there is one of considerable size, and several small fragments, on each side of the septum. Each of the larger cartilages forms a portion of an oval ring, which is placed obliquely on the side of the septum: so that the extre-

mity of the oval points downward and forward, while the middle part of the oval is directed upwards and backwards. The sides of this cartilage are flat, and unequal in breadth. The narrowest side is internal, and projects lower down than the cartilaginous septum; so that it is applied to its fellow of the other nostril. The external side is broader, and continues backward and upward to a considerable distance.

The upper and posterior part of this oval ring is deficient; but the remainder of the nostril consists of several small pieces of cartilage, which are fixed in a ligamentous membrane that is connected by each of its extremities to the oval cartilage, and thus completes the orifice.

The anterior parts of the oval cartilage form the point of the nose; and the ligamentous portions, the alæ or lateral parts of the nostrils.

When the external integuments and muscles are removed from the lower portion of the nose, so that the internal membrane and these cartilages only remain, the internal membrane will be found attached to the whole bony margin of each orifice, and to each side of the whole anterior edge of the middle cartilage, which projects beyond the bones. This membrane is afterwards continued so as to line the oval cartilages and the elastic membrane of the ala nasi, to the margin of the orifice of the nostril.

The internal portions of the oval cartilages being situated without the septum, and applied to each other, they form the external edge of the partition between the nostrils, or the columna nasi; which is very moveable upon the edge of the middle cartilage.

The orifices of the nostrils, thus constructed, are dilated by that portion of the muscle, called *Levator Labii Superioris Alæque Nasi*, which is inserted into the alæ nasi.

They are drawn down by the depressor labii superioris alæque nasi. They are pressed against the septum and the nose by the muscle called *Compressor Naris*, which has however an opposite effect when its upper extremity is drawn upwards by those fibres of the occipito-frontalis, which descend upon the nose, and are in contact with it.

The end of the nose is also occasionally drawn down, by some muscular fibres which descend from it, on the septum of the nose, to the orbicularis oris: they are considered as a portion of this muscle by many anatomists, but were described by Albinus as a separate muscle, and called *Nasalis Labii Superioris.*

When inspiration takes place with great force, the alæ nasi would be pressed against the septum, if they were not drawn out and dilated by some of the muscles above mentioned.

SECTION II.

Of the Cavities of the Nose.

To the description of the osseous parts of the nasal cavities in vol. i. page 72, it ought now to be added, that the vacuity in the anterior part of the osseous septum is filled up by a cartilaginous plate, connected with the nasal lamella of the ethmoid bone above, and with the vomer below. This plate sends off those lateral portions already described, which form the cartilaginous part of the bridge of the nose.

It should also be observed that at the back parts of these cavities are two orifices called the *Posterior Nares*, which are formed by the palate bones, the vomer, and the body of the sphenoidal bone, and are somewhat oval.

The nasal cavities, thus constructed, are lined by a peculiar membrane, which is called *pituitary* from its

secretion of mucus, or *Schneiderian* after an anatomist who described it with accuracy.*

This membrane is very thick and strong, and abounds with so many blood vessels, that in the living subject it is of a red colour. It adheres to the bones and septum of the nose like the periosteum, but separates from them more easily. The surface which adheres to the bones has some resemblance to periosteum, while the other surface is soft, spongy, and rather villous. Bichat seems to have considered this membrane as formed of *two lamina*, viz. periosteum, and the proper mucous membrane; but he adds, that it is almost impossible to separate them.

It has been supposed that many distinct glandular bodies were to be seen in the structure of this membrane by examining the surface next to the bones;† but this opinion is adopted by very few of the anatomists of the present day. The texture of the membrane appears to be uniform; and on its surface are a great number of follicles of various sizes, from which flows the mucus of the nose.

These follicles appear like pits, made by pushing a pin obliquely into a surface which retains the form of the impression. They can be seen very distinctly with a common magnifying glass when the membrane is immersed in water, both on the septum and on the opposite surface. They are scattered over the membrane without order or regularity, except that in a few places they occur so as to form lines of various lengths, from half an inch to an inch. The largest of them are in the lower parts of the cavities.

It may be presumed that the secretion of mucus is effected here by vessels which are mere continuations of arteries spread upon a surface analogous to the ex-

* Conrad Schneider, a German professor, in a large work, "De Catarrhis," published about 1660.

† See Winslow, Section X. No. 337.

halents, and not convoluted in circumscribed masses, as in the case of ordinary glands.

The arteries of this membrane are derived from various sources: the most important of them is the nasal branch of the internal maxillary, which passes into the nose through the spheno-palatine foramen, and is therefore called the *Spheno-palatine Artery*. It divides into several twigs, which are spent upon the different parts of the surface of the nasal cavities. Two of them are generally found on the septum of the nose: one, which is small, passes forwards near the middle; the other, which is much larger, is near the lower part of it.

Two small arteries, called the *anterior and posterior ethmoidals*, which are branches of the ophthalmic, enter the nose by foramina of the cribriform plate of the ethmoidal bone. These arteries pass from the orbit to the cavity of the cranium, and then through the cribriform plate to the nose. In addition to these, there are some small arteries derived from the infra orbital, the alveolar and the palatine, which extend to the Schneiderian membrane; but they are not of much importance.

The veins of the nose correspond with the arteries. Those which accompany the ethmoidal arteries open into the ocular vein of the orbit, which terminates in the cavernous sinuses of the head. The other veins ultimately terminate in the external jugulars.

The nerves of the nose form an important part of the structure; they are derived from several sources; but the most important branches are those of the olfactory.

The olfactory nerves form oblong bulbs, which lie on each side of the crista galli, on the depressed portions of the cribriform plate of the ethmoid bone, within the dura mater. These bulbs are of a soft consistence, and resemble the cortical part of the

brain mixed with streaks of medullary matter. They send off numerous filaments, which pass through the foramina of the ethmoid bone, and receive a coat from the dura mater as they pass through it.

These filaments are so arranged that they form two rows, one running near to the septum, and the other to the surface of the cellular part of the ethmoid bone, and the os turbinatum: and in addition to these are some intermediate filaments.

When the Schneiderian membrane is peeled from the bones to which it is attached, these nervous filaments are seen passing from the foramina of the ethmoid bone to the attached surfaces: one row passing upon that which covered the septum, and the other to that of the opposite side; while the intermediate filaments take an anterior direction, but unite to the membrane as soon as they come in contact with it.

All of these can be traced downwards on the aforesaid surfaces of the membrane for a considerable distance, when they gradually sink into the substance of the membrane, and most probably terminate on the internal villous surface; but they have not been traced to their ultimate termination. They ramify so that the branches form very acute angles with each other. On the septum the different branches are arranged so as to form brushes, which lie in contact with each other. On the opposite sides, the different ramifications unite so as to form a plexus.

Dr. Soemmering published last year some very elegant engravings of the nose, representing one of his dissections, which appears to have been uncommonly minute and successful.* These represent the ramifications as becoming more expanded and delicate in the progress towards their terminations, and as ob-

* They are entitled, Icones organorum humanorum olfactus.

serving a tortuous course, with very short meandering flexures.

It is to be observed that the ramifications of the olfactory nerve, thus arranged, do not extend to the bottom of the cavity. On the external side, they are not traced lower than the lower edge of the ethmoid, or of the superior spongy bone: and on the septum, they do not extend to the bottom, although they are lower than on the opposite side. On the parts of the membrane not occupied by the branches of the olfactory nerves, several other nerves can be traced. The nasal twig of the ophthalmic branch of the fifth pair, after passing from the orbit into the cavity of the cranium, proceeds to the nasal cavity on each side by a foramen of the cribriform plate; and after sending off some fibrillæ, descends upon the anterior part of the septum to the point of the nose. The spheno-palatine nerve, which is derived from the second branch of the fifth pair, and enters the nose by the spheno-palatine foramen, is spread upon the lower part of the septum and of the opposite side of the nose also, and transmits a branch through a canal in the foramen incisivum to the mouth. Several small branches also pass to the nose from the palatine and other nerves; but those already mentioned are the most important.

A question has been proposed, whether the olfactory nerve is exclusively concerned in the function of smelling, or whether the other nerves above mentioned are also concerned in it. It seems probable that this function is exclusively performed by the olfactory nerve, and that the other nerves are like the ophthalmic branch of the fifth pair, with respect to the optic nerve. In proof of this, it is asserted that the sense of smelling has entirely ceased in some cases, where the sensibility to mechanical irritation of every kind has remained unchanged. If the ol-

factory nerve alone is concerned in the function of smelling, it follows, that this function must be confined to the upper parts of the nasal cavities; but it ought to be remembered, that the structure of the Schneiderian membrane, in the lower parts of these cavities, appears exactly like that which is above.

The surface of the nasal cavities and their septum, when covered with the Schneiderian membrane, correspond with the osseous surface formerly described. The membrane covers the bones and cartilage of the septum, so as to make one uniform regular surface, From the upper part of the septum, it is continued to the under side of the cribriform plate of the ethmoid, and lines it; the filaments of the olfactory nerve passing through the foramina of that bone into the fibrous surface of the membrane. It is continued from the septum, and from the cribriform plate, to the internal surface of the external nose, and lines it. It is also continued backwards to the anterior surface of the body of the sphenoidal bone; and, passing through the foramina or openings of the sphenoidal cells, it lines these cavities completely; but in these, as well as the other cavities, its structure appears somewhat changed; it becomes thinner and less vascular.

At the above mentioned foramina, in some subjects, it forms a plate or fold, which diminishes the aperture considerably.

From the upper surface of the nasal cavities, the membrane is continued downwards over the surface opposite to the septum. On the upper flat surfaces of the cellular portions of the ethmoid, it forms a smooth uniform surface. After passing over the first turbinated bone, or that called after Morgagni, it is reflected into the groove, or upper meatus immediately within and under it; the fold formed by the membrane, as it is reflected into the meatus, is rather

larger than the bone: and the edge of the fold therefore extends lower down than the edge of the bone, and partly covers the meatus like a flap, consisting only of the double membrane. This fold generally continues backwards as far as the spheno-maxillary foramen, which it closes; the periosteum, exterior to the foramen, passing through it, and blending itself with the fibrous surface of the Schneiderian membrane within. Here the spheno-palatine nerves and arteries join the membrane. Below this meatus, it extends over the middle, (formerly called the upper,) turbinated bone, and is reflected or folded inwards on the under side of this bone, and continued into the middle meatus below it. In the middle meatus, which is partly covered by the last mentioned turbinated bone, there are two foramina; one communicating with the maxillary sinus, and the other with the anterior cells of the ethmoid and the frontal sinuses. The aperture into the maxillary sinuses is much less in the recent head, in which the Schneiderian membrane lines the nose, than it is in the bare bones. A portion of the aperture in the bones is closed by the Schneiderian membrane, which is extended over it: the remainder of the aperture is unclosed; and through this foramen, the membrane is reflected so as to line the whole cavity. As a portion of the foramen is covered by the membrane, and this portion, as well as the other parts of the cavity, is lined by the membrane, it is obvious that at the place where the membrane is extended over the foramen in the bone, it must be doubled; or, in other words, a part of the aperture of the maxillary sinus is closed by a fold of the Schneiderian membrane.

This aperture varies in size in different subjects, and is often equal in diameter to a common quill. It is situated in the middle of the meatus, and is covered

by the middle turbinated bone: immediately above it, is a prominence of the cellular structure of the ethmoid bone, which has a curved or semicircular figure. Near this prominence, in the same meatus, a groove terminates, which leads from the anterior ethmoid cells and the frontal sinuses.

From the middle meatus, the membrane proceeds over the inferior turbinated bone, and is reflected round and under it into the lower meatus. It appears rather larger than the bone which it covers; and therefore the lower edge of the bone does not extend so low as the lower edge of the membrane, which of course is like a fold or plait. The membrane then continues and lines the lower meatus: here it appears less full than it is in the turbinated bone. In this meatus, near to its anterior end, is the lower orifice of the lachrymal duct: this is simply lined by the Schneiderian membrane, which is continued into it, and forms no plaits or folds that affect the orifice.

Orifice of the Eustachian Tube.

Immediately behind each of the nasal cavities, on the external side, is the orifice of the *Eustachian Tube*. It has an oval form, and is large enough to admit a very large quill. Its position is oblique: the upper extremity being anterior to the other parts of the aperture, and on a line with the middle meatus, while the centre is behind the inferior turbinated bone. The lower part of the oval is deficient. This tube is formed posteriorly by a cartilaginous plate. It is lined by the membrane continued from the nose.

The cavities of the nose answer a two-fold purpose in the animal economy; they afford a surface for the expansion of the olfactory nerves, and a passage for the external air to the windpipe, in respiration.

The function of smelling appears to be dependent, to a certain degree, upon respiration. It has been asserted

that unless the air passes in a stream through the nose, as in respiration, the perception of odour does not take place; that in persons who breathe through wounds and apertures in the windpipe, the function of smelling is not performed. It is rather in confirmation of this proposition, that most persons, when they wish to have an accurate perception of any odour, draw in air rapidly through the nose.

Although the ultimate terminations of the olfactory nerves cannot be demonstrated like those of the optic and auditory nerves, it is probable, from the appearance of the fibres, while they are distinguishable, that they are finally arranged with great delicacy. It is certain that the impressions from whence we derive the perceptions of many odours must be very slight; as some odorous bodies will impregnate the air of a large chamber for a great length of time, without losing any sensible weight.

With respect to delicacy of structure and sensibility, it is probable that the nose holds a middle rank between the eye or ear, and the tongue: and on this account the mucus is necessary as a covering and defence of its surface.

It has been ascertained, by the investigations of chemists, that this mucus contains the same ingredients as the tears already described, namely, animal mucus and water; and muriate of soda, and soda uncombined; phosphate of lime, and phosphate of soda.

The animal mucus, which is a most important ingredient in the composition, resembles the mucilage formed by some of the vegetable gums in several particulars; and differs from them in others.

The mucus of the nose, if it remain there long after it is secreted, becomes much more viscid in consistence, and changes from a whitish colour to one which partakes more or less of the yellow. It is probable that an incipient putrefaction may occasion these changes in it.

The use of the frontal, maxillary and other sinuses, communicating with the nose, has been the subject of some inquiry. As there can be no stream of air through them, and as the membrane lining them is neither so thick, villous nor flexible as that lining the nose, it may be concluded, a priori, that they are not concerned in the function of smelling. This

opinion is strengthened by the fact, that very young children, in whom these sinuses scarcely exist, enjoy the sense of smelling in perfection. The following fact is also in support of it. The celebrated Desault attended a patient, in whom one of the frontal sinuses was laid open by the destruction of the bone which covered it anteriorly. This patient was able to breathe a short time through the sinus when the mouth and nose were closed: at the request of Desault he breathed in this manner when a cup of some aromatic liquor was held near the opening of the sinus, and had not the least perception of odour. This experiment was repeated several times.

Many *physiologists* believe that these sinuses have an effect in modulating the voice.

CHAPTER II.

OF THE MOUTH.

The general cavity of the mouth is formed anteriorly and laterally by the connexion of the lips and cheeks to the upper and lower jaws; so that the teeth and the alveoli of both jaws may be considered as within the cavity. Above, it is bounded principally by the palatine processes of the upper maxillary and palate bones, and the soft palate, which continues backward from them in the same direction.

Below, the cavity is completed by several muscles, which proceed from almost the whole internal circumference of the lower jaw, and, by their connexions with each other, with the tongue and the os hyoides, form a floor or bottom to it. The tongue is particularly connected to this surface, and may be considered as resting upon and supported by it.

To acquire an idea of the parietes of this cavity, after studying the upper and lower maxillary bones, the orbicularis oris and the muscles connected with it, especially the buccinator, ought to be examined; and also the digastricus, the mylo-hyoideus, genio-hyoideus, and genio-hyoglossus. By this it will appear that the lips and cheeks, and the basis or floor of the mouth, are formed in a great measure by muscles. Upon the internal surface of these muscles, a portion of cellular and adipose substance is arranged, as well as glandular bodies of different sizes; and to these is attached the membrane which lines the inside of the mouth.

This membrane passes from the skin of the face to the lips, and the inside of the mouth; and, although it is really a continuation of the skin, there

is so great a change of structure, that it ought to be considered as a different membrane. At the orifice of the lips it is extremely thin, and so vascular, that it produces the fine florid colour which appears there in health. It is covered by a cuticle, called by some anatomists, *Epithelium*, which has a proportionate degree of delicacy, and can be separated like the cuticle in other parts. When this cuticle is separated, the lips and the membrane of the mouth appear to be covered with very fine villi, which are particularly apparent in some preparations of the lips after injection and maceration.*

Under this membrane are many small glandular bodies of a roundish form, called glandulæ labiales, whose excretory ducts pass through it to the inner surface of the mouth, for the purpose of lubrifying it with their secretion, which is mingled with the saliva.

The membrane which lines the inside of the lips and cheeks, is somewhat different from that which forms the surface of the orifice of the mouth: it is not so florid; the blood vessels in its texture are larger, and not so numerous. This change, however, takes place very gradually, in the progress of the membrane, from the orifice of the lips to the back part of the cheeks. Glandular bodies, like those of the lips, are situated immediately exterior to this membrane of the cheeks, between it and the muscles: their ducts open on its surface. These glands are called *Buccales*.

This lining membrane is continued from the internal surface of the lips and cheeks to the alveolar portions of the upper and lower jaws, which are in the cavity of the mouth, and covers them, adhering firmly to the periosteum.

* Ruysch had a fine preparation of this structure. See Thesaurus VII. Tab. III. Fig. 5.

The teeth appear to have passed through apertures in this membrane, and are surrounded by it closely at their respective necks.

The portion of membrane, which thus invests the jaws, constitutes the *gums;* which have now acquired a texture very different from that of the membrane from which they were continued. They are extremely firm and dense, and very vascular. It is probable that their ultimate structure is not perfectly understood.

In the disease called *scurvy*, they tumefy and lose the firmness of their texture: they acquire a livid colour, and are much disposed to hemorrhage.

From the alveoli of the upper jaw, the lining membrane is continued upon the palatine processes of the upper maxillary and palate bones, or the roof of the mouth.

This membrane of the plate is not quite so firm as that of the gums, and is also less florid: it adheres firmly to the periosteum, and thus is closely fixed to the bones. There is generally a ridge on its surface, immediately under the suture between the two upper maxillary bones; and some transverse ridges are also to be seen upon it. On the internal surface of this membrane are small glandular bodies, whose ducts open on the surface of the palate.

It is asserted, that this membrane has a limited degree of that sensibility which is essential to the function of tasting; and that if certain sapid substances are carefully applied to it, their respective tastes will be perceived, although they have not been in contact with the tongue.

The membrane is continued from the bones above mentioned to the soft palate, or velum pendulum palati, which is situated immediately behind them. This soft palate may be considered as a continuation of the partition between the nose and mouth; it is at-

tached to the posterior edge of the palatine processes of the ossa palati, and to the pterygoid processes of the sphenoidal bone. Its interior structure is muscular. The upper surface is covered by the membrane of the nose, the lower surface by the membrane which lines the mouth.

The muscles, which contribute to the composition of this structure, are the circumflexi, and the levatores palatine above, and the constrictors isthmi faucium and palato-pharyngei below. (See vol. i. page 198—199.) Thus composed, the soft palate constitutes the back part of the partition between the nose and mouth. When viewed from before, with the mouth open, it presents towards the tongue an arched surface, which continues downwards on each side, until it comes nearly in contact with the edges of that organ. On each of the lateral parts of this arch, are two pillars, or rather prominent ridges, which project into the mouth. These ridges are at some distance from each other below, and approach much nearer above, so that they include a triangular space. They are called the *lateral half arches* of the palate. Each of them is formed by a plate or fold of the lining membrane of the mouth, and contains one of the two last mentioned muscles: the anterior, the constrictor isthmi faucium; the posterior, the palato-pharyngeus. These muscles, of course, draw the palate down toward the tongue when they contract.

From the centre of the arch, near its posterior edge, is suspended the uvula, a conical body, which varies in length from less than half an inch, to rather more than one inch. It is connected by its basis to the palate; but its apex is loose and pendulous. This body is covered by the lining membrane of the mouth. It contains many small glands, and a muscle also, the azygos uvulæ, which arises from the posterior edge of the ossa palati, at the suture which connects

them to each other, and, passing posteriorly upon the soft palate, extends from the basis to the apex of the uvula, into which it is inserted. By the action of this muscle, the length of the uvula can be very much diminished: and when its contraction ceases, that body is elongated.

The pendulous part of the uvula can also be moved, in certain cases, to either side.

It is commonly supposed, that the principal use of this little organ is to modulate the voice; but there are good reasons for believing, that it has another object. It was remarked by Fallopius, (and the observation has been confirmed by many surgeons since his time,) that the uvula may be removed completely without occasioning any alteration of the voice, or any difficulty of deglutition, if the soft palate be left entire.

The soft palate is so flexible, that it yields to the actions of the levatores palati, which draw it up so as to close the posterior nares completely.

It also yields to the circumflexi or tensores, which stretch it so as to do away its arched appearance.

It is therefore very properly called the *Palatum. Molle*. It is also frequently called the *Velum Pendulum palati*, from the position which it assumes.

The Tongue,

Which is a very important part of this structure, is retained in its position and connected with the parts adjoining it, by the following arrangements.

The os hyoides, which, as its name imports, resembles the Greek letter *υ*, or half an oval, is situated rather below the angles of the lower jaw, in the middle of the upper part of the neck. It is retained in its position by the sterno-hyoidei muscles, which connect it to the upper part of the sternum, by the coraco-hyoidei, which pass to it obliquely from the sca-

pula; by the thyro-hyoidei, which pass to it directly upward from the thyroid cartilage: all of which connect it to parts below. To these should be added the stylo-hyoidei, which pass to it obliquely from behind and rather from above; the mylo-hyoidei, which come rather anteriorly from the lateral parts of the lower jaw; and the genio-hyoidei, which arise from a situation directly anterior and superior the chin. When these muscles are at rest, the situation of the os-hyoides is, as above described, below the angles of the lower jaw: when those, in one particular direction, act while the others are passive, the bone may be moved upwards or downwards, backwards or forwards, or to either side. This bone may be considered as the basis of the tongue; for the posterior extremity of that organ is attached to it, and of course the movements of the bone must have an immediate effect upon those of the tongue.

The tongue is a flat body of an oval figure, but subject to considerable changes of form.

The posterior extremity, connected to the os-hyoides, is commonly called its basis; the anterior extremity, which, when the tongue is quiescent, is rather more acute, is called its apex.

The lower surface of the tongue is connected with a number of muscles, which are continued into its substance. This connexion is such, that the edges of the tongue are perfectly free and unconnected; and so is the anterior extremity for a considerable distance from the apex towards the base.

The substance of the tongue consists principally of muscular fibres intermixed with a delicate adipose substance. It is connected to the os-hyoides by the hyoglossus muscle, and also by some other muscular fibres, as well as by a dense membranous substance, which appears to perform the part of a ligament.

This connexion is also strengthened by the continuance of the integuments from the tongue to the epiglottis cartilage, to be hereafter described; for that cartilage is attached by ligaments to the os-hyoides.

The tongue is thin at its commencement as the os-hyoides; but it soon increases in thickness. The muscular fibres in its composition have been considered as intrinsic, or belonging wholly to its internal structure; and extrinsic, or existing in part outside of this structure. The lingualis muscles are intrinsic: (vol. i. page 197;) they are situated near the under surface of the tongue, one on each side, separated from each other by the genio-hyo-glossi muscles, and extending from the basis of the tongue to its apex. These muscles can be easily traced as above described; but there are also many fibres in the structure of the tongue, which seem to pass in every direction, and of course are different from those of the lingualis muscles. To these two sets of fibres are owing many of the immensely varied motions of the different parts of the tongue.

In addition to these, are the extrinsic muscles, which originate from the neighbouring parts, and are inserted and continued into the substance of the tongue.

Among the most important of these muscles, are those which proceed from the chin, or the genio-hyo-glossi. They are in contact with each other; their fibres radiate from a central point on the inside of the chin, and are inserted into the middle of the lower surface of the tongue: the insertion commencing at a short distance from its apex, and continuing to its base.

As the genio-hyo-glossi muscles have a considerable degree of thickness, they add much to the bulk of the tongue in the middle of the posterior parts of it.

The hyo-glossi and the stylo-glossi, being continued

into the posterior and lateral parts, contribute also to the bulk of these parts.

The tongue, thus composed and connected, lies, when at rest, on the mylo-hyoidei muscles; and the space between it and these muscles is divided into two lateral parts by the above described genio-hyoglossi. In the space above mentioned, is a small salivary gland, of an irregular oval form; the greatest diameter of which extends from before backwards, and its edges present outwards and inwards. It has several excretory ducts, the orifices of which form a line on each side of the tongue. This gland is very prominent under the tongue; and when the tongue is raised it is particularly conspicuous, it is called the *Sublingual.*

The lining membrane of the mouth continues from the inside of the alveoli of the lower jaw, which it covers, over the sublingual glands to the lower surface of the tongue. In this situation it is remarkably thin; but, as it proceeds to the upper surface of the tongue, its texture changes considerably, and on this surface it constitutes the organ of taste.

The upper surface of the tongue, although it is continued from the thin membrane above described, is formed by a rough integument which consists, like the skin, of three lamina. The cuticle is very thin; and under it, the rete mucosum* is thicker and softer than in other places.

The true skin here abounds with eminences of various sizes and forms, all of which are denominated *Papillæ.* The largest of these are situated on the posterior part of the tongue, and are so arranged that they form an angle rather acute, with its point back-

* M. Bichat appears to have had doubts whether the real rete mucosum existed here. He says that he could only perceive a decussation of vessels in the intervals of the papillæ, which, as he supposes, occasioned the florid colour of the tongue.

wards. They are commonly nine in number: they resemble an inverted cone, or are larger at their head than their basis. They are situated in pits or depressions, to the bottoms of which they are connected. In many of them there are follicles, or perforations, which have occasioned them to be regarded as glands. They are called *Papillæ Maximæ*, or *Capitatæ*.

The papillæ, next in size, are denominated *fungiform* by some anatomists, and *Mediæ*, or Semilenti*culares* by others. They are nearly cylindrical in form, with their upper extremities regularly rounded. They are scattered over the upper surface of the tongue, in almost every part of it, at irregular distances from each other.

The third class are called *conoidal* or *villous*. They are very numerous, and occupy the greatest part of the surface of the tongue. Although they are called *conoidal*, there is a great difference in their form; many of them being irregularly angular and serrated as well as conical.

Soemmering and other German anatomists consider the smallest papillæ as a fourth class, which they call the *filiform:* these lie between the others.

It is probable that these papillæ are essential parts of the organ of taste; and their structure is of course an interesting object of inquiry.

The nerves of the tongue have been traced to the papillæ, and have been compared by some anatomists to the stalk of the apple, while the papillæ resembled the fruit; but their ultimate termination does not appear to have been ascertained.*

* In the explanation of the plates, referred to in the following sentence, Soemmering observes, that when the fibrillæ of the lingual nerve of the fifth pair are traced to the papillæ of the second class, they swell out into a conical form; and these nervous cones are in such close contact with each other, that the point of the finest needle could not be insinuated into the papillæ without touching a nerve.

Soemmering has lately published some elegant engraved copies of drawings of these papillæ, when they were magnified twenty-five times; from which it appears that a very large number of vessels, particularly of arteries, exist in them. These vessels are arranged in a serpentine direction, and are prominent on the surface; but they appear doubled, and the most prominent part is the doubled end.—This arrangement of vessels is perceptible on the sides of the tongue, as well as on the papillæ.

Behind the large papillæ is a foramen, first described by Morgagni, and called by him *Foramen Cœcum.* It is the orifice of the cavity which is not deep; the excretory ducts of several mucous glands open into it.

On the upper surface of the tongue, a groove is often to be seen, which is called the *linea mediana,* and divides it into two equal lateral parts. Below, the lining membrane of the mouth, as it is continued from the lower jaw to the tongue, forms a plait, which acts as a ligament, and is called the *frænum linguæ.* It is attached to the middle of the tongue, at some distance behind the apex.

The tongue is well supplied with blood vessels, which are derived from the *lingual branch* of the external carotid on each side. This artery passes from the external carotid, upwards, inwards, and forwards, to the body of the tongue. In this course it sends off several small arteries to the contiguous parts, and one which is spent about the epiglottis and the adjoining parts, called the *Dorsalis Linguæ.* About the anterior edge of the hyo-glossus muscle, it divides into two large branches: one of which, called the *Sublingual,* passes under the tongue between the genio-hyo-glossus and the sublingual gland, and extends near to the symphisis of the upper jaw; sending branches to the sublingual gland, to the mus-

cles under the tongue, to the skin, and the lower lip. The other is in the substance of the tongue, on the under side near the surface, and extends to the apex.

The veins of this organ are not so regular as the arteries: they communicate with the external jugular, and some of them are always very conspicuous under the tongue: these are called *ranular.*

It is to be observed, that the vessels on each side have but little connexion with each other; for those of one side may be injected while the others continue empty.

The tongue is also well supplied with nerves, and derives them from three different sources on each side, namely, from the fifth, the eighth, and ninth pairs of the head.

The lingual portion of the third branch of the fifth pair, passing under the tongue, enters its substance about the middle, and forms many minute branches, which pass to the papillæ of the fore part of the tongue.

The glosso-pharyngeal portion of the eighth pair, sending off several branches in its course, passes to the tongue near its basis, and divides into many small branches, which are spent upon the sides and middle of the root of the tongue, and also upon the large papillæ.

The ninth pair of nerves are principally appropriated to the tongue. They pass on each side to the most fleshy part of it, and after sending one branch to the mylo-hyoideus, and another to communicate with the lingual branch of the fifth pair, they are spent principally upon the genio-glossi, and linguales muscles.

The tongue answers a threefold purpose. It is the principal organ of taste. It is a very important agent in the articulation of words, and it assists in

those operations upon our food, which are performed in the mouth.

The Salivary Glands.

The salivary glands have such an intimate connexion with the mouth that they may be described with it.*

There are three principal glands on each side: the *Parotid* the *Submaxillary* and the *Sublingual.* They are of a whitish or pale flesh-colour, and are composed of many small united masses or lobuli, each of which sends a small excretory duct to join similar ducts from the other lobuli, and thereby form the great duct of the gland.

The *Parotid* is much larger than the other glands. It occupies a large portion of the vacuity between the mastoid process and the posterior parts of the lower jaw. It extends from the ear and the mastoid process over a portion of the masseter muscle, and from the zygoma to the basis of the lower jaw. Its name is supposed to be derived from two Greek words which signify contiguity to the ear. It is of a firm consistence. It receives branches from the external carotid artery and from its facial branch.

From the anterior edge of this gland, rather above the middle, the great duct proceeds anteriorly across the masseter muscle; and, after it has passed over it bends inward through the adipose matter of the cheek to the buccinator muscle, which it perforates obliquely and opens on the inside of the cheek opposite to the interval between the second and third molar teeth of the upper jaw. The aperture of the duct is rather less than the general diameter of it, and this circumstance has the effect of a valve. When the duct leaves the parotid, several small

* For a general account of glands, see the appendix to this volume.

glandular bodies called sociæ parotidis, are often attached to it, and their ducts communicate with it. The main duct is sometimes called after Steno, who first described it.

When the mouth is opened wide, as in gaping, there is often a jet of saliva from it into the mouth.

The parotid gland furnishes the largest proportion of saliva.

It covers the nerve called *Portio Dura*, after it has emerged from the foramen stylo-mastoideum.

The second gland is called the *Submaxillary*. It is much smaller than the parotid, and rather round in form. It is situated immediately within the angle of the lower jaw, between it on the outside, and the tendon of the digastric muscle and the ninth pair of nerves internally. Its posterior extremity is connected by cellular membrane to the parotid gland; its anterior portion lies over a part of the mylo-hyoideus muscles; and from it proceeds the excretory duct, which is of considerable length, and passes between the mylo-hyoideus and the genio-glossus muscles along the under and inner edge of the sublingual gland. In this course the duct is sometimes surrounded with small glandular bodies, which seem to be appendices to the sublingual gland. It terminates under the tongue, on the side of the frænum linguæ, by a small orifice which sometimes forms a papilla.*

The orifice is often smaller than the duct; in consequence of which, obstruction frequently occurs here, and produces the disease called *ranula*.

The sublingual gland, which has already been mentioned, lies so that, when the tongue is turned up, it

* Lassus informs us that Oribases, afterwards all the Arabians, and subsequently Guy De Chauliac, Lanfranc, Achillini, Berenger De Carpi, Charles Etienne, Casserius and several others have given the description of these salivary ducts; notwithstanding which Wharton, a physician of London, attributed to himself the discovery of them on the bullock in 1656.—Ed.

can be seen protruding into the cavity of the mouth, and covered by the lining membrane, which seems to keep it fixed in its place. It lies upon the mylo-hyoideus, by the side of the genio-hyoideus; and is rather oval in form, and flat. Its greatest length is from before backwards; its position is rather oblique, one edge being placed obliquely inwards and upwards, and the other outwards and downwards. It has many short excretory ducts, which open by orifices arranged in a line on each side: they are discovered with difficulty on account of their small size, and sometimes amount to eighteen or twenty in number. In some few instances, this gland sends off a single duct, which communicates with the duct of the submaxillary gland.

The salivary fluid secreted by these glands is inodorous, insipid, and limpid, like water; but much more viscid, and of greater specific gravity. Water constitutes at least four-fifths of its bulk; and animal mucus one half of its solid contents. It also contains some albumen, and several saline substances; as the muriate of soda, and the phosphates of lime, of soda, and of ammonia.

It is probable that this fluid possesses a solvent power with respect to the articles of food.

There are small glandular bodies, situated between the masseter and buccinator muscles, opposite to the last molar tooth of the upper jaw, whose nature is not well understood: they are called *Glandulæ Molares*.

The motions of the tongue are very intelligible to a person who has a preparation of the lower jaw before him, with the tongue in its natural situation, and the muscles which influence it, properly dissected. Its complicated movements will appear the necessary result of the action of those muscles upon it, and the os-hyoides; and also upon the larynx, with which the os-hyoides is connected. The muscular fibres

of the tongue itself are also to be taken into this view, as they act a very important part.

Although the tongue appears very necessary, in a mechanical point of view, to the articulation of many words, yet there are cases where it has been entirely deficient, in which the parties thus affected, have been able to speak very well in general, as well as to distinguish different tastes.*

The tongue is also a very delicate organ of touch.—We can perceive the form of the teeth, and the state of the surface of the mouth, more accurately by the application of the tongue than of the fingers.

On the three nerves which go to the tongue, it is generally supposed that the lingual portion of the third branch of the fifth pair is most immediately concerned in the function of tasting, as it passes to the front part of the surface of the tongue. The glosso-pharyngeal are probably concerned in the same function on the posterior part, while the ninth pair of nerves seems principally spent upon the muscular parts of the organ.

It is obvious that the tongue is most copiously supplied with nerves. This probably accounts for the great facility of its motions, and the power of continuing them.

* There is a very interesting paper on this subject, in the Memoirs of the Academy of Sciences for the year 1718, by *Jussieu;* in which he describes the case of a female, fifteen years old, examined by himself, who was born without a tongue. In this paper he refers to another case, described by *Rolland,* a surgeon of Saumur, of a boy nine years old, whose tongue was destroyed by gangrene. In each of these cases the subject was able to articulate very well, with the exception of a few letters; and also enjoyed the sense of taste.

CHAPTER III.

OF THE THROAT.

To avoid circumlocution, the word *throat* is used as a general term to comprehend the structure which occurs behind the nose and mouth, and above the œsophagus and trachea. This structure consists,

1st. Of the parts immediately behind the mouth, which constitutes the *Isthmus* of the *Fauces:*

2nd. Of the parts which form the orifice of the windpipe, or the *Larynx;*—and

3d. Of the muscular bag, which forms the cavity behind the nose and mouth, that terminates in the œsophagus, or the *Pharynx.*

SECTION I.

Of the Isthmus of the Fauces.

In the back part of the mouth, on each side, are to be seen the two ridges or half arches, passing from the soft palate of the root of the tongue, mentioned in page 25, and said to be formed by plaits of the skin containing muscular fibres. The anterior plait, which contains the muscle called *Constrictor Isthmi Faucium,* passes directly from the side of the root of the tongue to the palate, and terminates near the commencement of the uvula. The posterior plait runs from the palate obliquely downwards and backwards, as it contains the palato-pharyngeus muscle, which passes from the palate to the upper and posterior part of the thyroid cartilage.

In the triangular space between these ridges is situated a glandular body, called the *Tonsil Amyg-*

dala. This gland has an oval form, its longest diameter extending from above downwards. Its surface is rather convex, its natural colour is a pale red. On its surface are the large orifices of many cells of considerable size, which exist throughout the gland. These cells often communicate with each other, so that a probe can be passed in at one orifice and out at the other.

Into these cells open many mucous ducts, which discharge the mucus of the throat, for the purpose of lubricating the surface, and facilitating the transmission of food.

The epiglottis, or fifth cartilage of the larynx, is situated at the root of the tongue, in the middle, between the tonsils. The part which is in sight is partly oval in form, and of a whitish colour. Its position, as respects the tongue, is nearly perpendicular, and its anterior surface rather convex.

The membrane continued from the tongue over the epiglottis is so arranged that it forms a plait, which extends from the middle of the root of the tongue along the middle of the anterior surface of the epiglottis, from its base upwards.

On each side of this plait, or frænum, at the junction of the surfaces of the tongue and of the epiglottis there is often a depression, in which small portions of food sometimes remain; and a small frænum, similar to that above described, is sometimes seen on the outside of each of these cavities.

The epiglottis is situated immediately before the opening into the larynx.

The above described parts can be well ascertained in the living subject, by a person who has a general knowledge of the structure. Thus, looking into the mouth, with the tongue depressed, the uvula and soft palate are in full view above, and the epiglottis is very perceptible below; while the two ridges or la-

teral half arches can be seen on each side, with the tonsil between them.

SECTION II.

Of the Larynx.

In this structure are five cartilages, upon which its form and strength depends, namely, the *Cricoid*, the *Thyroid*, the two *Arytenoid*, and the *Epiglottis*. These cartilages are articulated to each other, and are supplied with muscles by which certain limited motions are effected.

The basis of the structure is a cartilaginous ring, called the *cricoid* cartilage, which may be considered as the commencement of the windpipe.

It may be described as an irregular section of a tube: its lower edge connected with the windpipe, being nearly horizontal when the body is erect; and the upper edge very oblique, sloping from before, backwards and upwards: in consequence of this, it has but little depth before, but is eight or nine lines deep behind.

The *Thyroid* cartilage is a single plate, bent in such manner that it forms an acute angle with two similar broad surfaces on each side of it. It is so applied to the cricoid cartilage, that the lower edge of the angular part is at a small distance above the front part of that cartilage, and connected to it by ligamentous membrane; while its broad sides are applied to it laterally, and thus partially enclose it.

The upper edge of the angular part of the thyroid cartilage forms a notch; and the natural position of the cartilage is such, that this part is very prominent in the neck; it is called the *Pomum Adami*.

Both the upper and lower edges of the thyroid cartilage terminate posteriorly in processes, which are

called *Cornua.* The two uppermost are longest: they are joined by ligaments to the extremities of the os-hyoides. The lower and shorter processes are fixed to the cricoid cartilage. The thyroid cartilage, therefore, partly rests upon the cricoid cartilage below, and is attached to the os-hyoides above. It is influenced by the muscles which act upon the os-hyoides, and also by some muscles which are inserted into itself. It is moved obliquely downwards and forwards, in a slight degree, upon the cricoid cartilage, by a small muscle, the crico-thyoideus, which arises from that cartilage and is inserted into it.

The *Arytenoid* cartilages are two small bodies of a triangular pyramidal form, but slightly curved backwards. They are placed upon the upper and posterior edge of the cricoid cartilage, near to each other; and their upper ends, taken together, resemble the mouth of a pitcher or ewer; from which circumstance their name is derived. Their bases are broad; and on their lower surfaces is a cavity, which corresponds with the convex edge of the cricoid cartilage, to which they are applied. At these places, a regular moveable articulation is formed, by a capsular ligament between each of these cartilages and the cricoid, in consequence of which they can be inclined backward or forward, inward or outward.

From the anterior part of each of these cartilages, near the base, a tendinous cord passes forward, in a direction which is horizontal when the body is erect, to the internal surface of the angle of the thyroid. These ligaments are not perfectly parallel to each other; for they are nearer before than behind. The aperture between them is from two to five lines wide when the muscles are not in action; and this aperture is the orifice of the windpipe: for the exterior space, between these ligaments and the circumference of the thyroid, is closed up by membrane and muscle,

At a small distance above these ligaments are two others, which also pass from the arytenoid to the thyroid cartilages. They are not so tendinous and distinct as the first mentioned, and cannot be drawn so tense by the muscles of the arytenoid cartilages. They are also situated at a greater distance from each other, and thus form a large aperture.

On the external side of the upper extremity of each of the arytenoid cartilages, and nearly in contact with it, is a small cartilaginous body, not so large as a grain of wheat, and nearly oval in form. These are connected firmly to the arytenoid cartilages, and are called their *appendices*. Being in the margin of the aperture of the larynx, they have an effect upon its form.

The arytenoid cartilages are the posterior parts of the larynx: the *Epiglottis,* which has already been mentioned is the anterior. When this cartilage is divested of its membrane, it is oval in its upper extremity, and rather angular below, terminating in a long narrow process, which is like the stalk of a leaf.

It is firmly attached to the internal surface of the angular part of the thyroid by this lower process; and, being placed in a perpendicular position, one of its broad surfaces is anterior towards the tongue, and the other posterior, towards the opening of the windpipe.

It is attached to the os-hyoides by dense cellular texture or ligament, and to the tongue by those plaits of the membrane of the mouth which have been already described.

It is elastic, but more flexible than the other cartilages; being somewhat different in its structure.—Its surface is perforated by the orifices of many mucous ducts.

There is a small space between the lower part of this cartilage, and the upper part of the thyroid and

the ligamentous membrane passing from it to the os hyoides. In this is a substance, which appears to consist of glandular and of adipose matter. It is supposed that some of the orifices on the lower part of the epiglottis communicate with this substance.

In the erect position of the body, the epiglottis is situated rather higher up than the arytenoid cartilages, and at the distance of ten or twelve lines from them.

The membrane which covers the epiglottis, is extended from each side of it to the arytenoid cartilages, and being continued into the cavity of the larynx, as well as upon the general surface of the throat, it is necessarily doubled: this doubling forms the lateral margins of the orifice of the cavity of the larynx. In these folds of the membrane are seen very delicate muscular fibres, called the *Aryteno-epiglottidei.*

The membrane continues down the cavity of the larynx, and, covering the upper ligaments, penetrates into the vacuity between them and the lower ligaments, so as to form a cavity on each side of the larynx, opening between the two ligaments, which is called the *Ventricle of Morgagni.* The shape of these cavities is oblong. Its greatest length extends from behind forward, on each side of the opening into the windpipe formed by the two lower or principal ligaments; so that when the larynx is removed from the subject, upon looking into it from above, you perceive three apertures: one in the middle, formed by the two lower ligaments; and one on each side of it, between the lower and upper ligament, which is the orifice of the ventricle of Morgagni.

The aperture between the two lower ligaments is called the *Rima Glottidis,* or *Chink of the Glottis;* the upper aperture, formed by the fold of the mem-

brane extending from the epiglottis to the arytenoid cartilages, may be termed *Glottis.*

If the windpipe is divided near the larynx, and the larynx inverted, so that the rima glottidis may be examined from below, the structure appears still more simple: it resembles a septum fixed abruptly in the windpipe, with an aperture in it of the figure of the rima glottidis.

The anterior surface of the two arytenoid cartilages is concave. This concavity is occupied in each by a glandular substance, which lies between the cartilage and the lining membrane; and extends itself horizontally, covered by the upper ligament of the glottis. The nature of these bodies is not perfectly understood; but they are supposed to secrete mucus.

The membrane which lines the cavity of the glottis being continued from the mouth and throat, resembles the membranes which invest those parts. In some places, where it is in close contact with the cartilages, it appears united with the perichondrium, and acquires more firmness and density.

The *general* motions of the larynx are very intelligible to those who are acquainted with the muscles which are connected with the thyroid cartilage, and which move the os-hyoides. They take place particularly in deglutition, and in some modifications of the voice; and also in vomiting.

The motions of the *particular* cartilages on each other can also be well understood, by attending to the origin and insertion of the various small muscles connected with them. The most important of these muscles are the crico-arytenoidei postici and laterales, the thyreo-arytenoidei, the arytenoidei obliqui, and the arytenoideus transversus. The effects of their actions appear to be the dilating or contracting the rima glottidis, and relaxing or extending the ligaments which form it.

The arteries of the larynx are derived from two sources, namely, the superior thyroid, or laryngeal branch of the external carotid, and the thyroid branch of the subclavian.

The nerves of the larynx also come to it in two very different directions on each side. It receives two branches from the par vagum; one which leaves that nerve high up in the neck, and is called the *Superior Laryngeal* branch; and another which proceeds from it after it has passed into the cavity of the thorax, and is called from its direction the *Recurrent.*

The extreme irritability of the glottis is unequivocally demonstrated by the cough which is excited when a drop of water, or any other mild liquid, or a crumb of bread enters it. Notwithstanding this, a flexible tube, or catheter, has several times been passed into the windpipe through the rima glottidis, and been endured by the patient a considerable time.

The cough, which occurs when these parts are irritated, does not appear to arise exclusively from the irritation of the membrane within the glottis; for, if it were so, mucilaginous substances, when swallowed slowly, could not suspend it. Their effect in relieving cough is universally known; and as they are only applied to the surface exterior to the glottis, it is evident that the irritation of this surface must also produce coughing.

Several curious experiments have been made to determine the effect of dividing the different nerves which go to the larynx; by which it appears that the recurrent branches supply parts which are essentially necessary to the formation of the voice, whilst the laryngeal branches supply parts which merely influence its modulation, or tone. See Mr. Haighton's Essay on this subject: Memoirs of the Medical Society of London, vol. iii.

The Thyroid Gland

May be described here, although a part of it is situated below the larynx.

This body consists of two lobes, which are united at their lower extremities by a portion which extends across the anterior part of the windpipe. Each lobe generally rises upwards and backwards from the second cartilaginous ring of the windpipe over the cricoid cartilage and a portion of the thyroid. It lies behind the sterno-hyoidei, and sterno-thyroidei muscles. It is of a reddish-brown colour, and appears to consist of a granulous substance; but its ultimate structure is not understood. It is plentifully supplied with blood, and receives two arteries on each side: one from the laryngeal branch of the external carotid: and the other from the thyroid branch of the subclavian.

Notwithstanding this large supply of blood, there is no proof that it performs any secretion: for although several respectable anatomists have supposed that they discovered excretory ducts passing to the windpipe, larynx, or tongue, it is now generally agreed that such excretory ducts are not to be found. Several instances have however occurred, in which air has been forced, by violent straining, from the windpipe into the substance of this gland.*

*There are two membranous expansions in the neck which should be noticed in its dissection. The first, called Fascia Superficialis, lies immediately beneath the skin, may be considered as a continuation of the fascia superficiales abdominis, and is strongly connected to the base of the lower jaw, being also spread over the parotid gland. It is not very distinct in all subjects. The second is called the Fascia Profunda Cervicis; it extends from the larynx and thyroid gland to the upper part of the sternum and first ribs, the great vessels, &c. of the superior mediastinum are placed immediately below it.—Ed.

SECTION III.

Of the Pharynx.

The pharynx is a large muscular bag, which forms the great cavity behind the nose and mouth that terminates in the œsophagus.

It has been compared to a funnel, of which the œsophagus is the pipe; but it differs from a funnel in this respect, that it is incomplete in front, at the part occupied by the nose and mouth and larynx.

It is connected above, to the cuneiform process of the occipital bone, to the pterygoid processes of the sphenoidal, and to both the upper and lower maxillary bones. It is in contact with the cervical vertebræ behind; and, opposite to the cricoid cartilage, it terminates in the œsophagus.

If the pharynx and œsophagus be carefully dissected and detached from the vertebræ, preserving the connexion of the pharynx with the head, and the head then be separated from the body, by dividing the articulation of the atlas and the os-occipitis, and cutting through the soft parts below the larynx, the resemblance to a funnel will be very obvious.

In this situation, if an incision be made from above downwards through the whole extent of the posterior part of the pharynx, the communication of the nose, mouth, and windpipe, with this cavity, will be seen from behind at one view.

The openings into the nose, or the posterior nares, appear uppermost. Their figure is irregularly oval, or oblong; they are separated from each other by a thin partition, the vomer. Immediately behind, on the external side of each of these orifices, is the *Eustachian tube.*

The soft palate will appear extending from the lower boundary of the posterior nares, obliquely

backwards and downwards, so as nearly to close the passage into the mouth. The uvula hangs from it: and, on each side of the uvula, the edge of the palate is regularly concave.

Below the palate, in the isthmus of the fauces, are the ridges or half arches, and the tonsils between them. The half arch which presents first, in this view, runs obliquely downward and backward, and not parallel to the other.

Close to the root of the *tongue* is the epiglottis erect; and, immediately adjoining it, is an aperture large enough to admit the end of a middle-sized finger. This aperture is widest at the extremity next to the epiglottis, and rather narrower at the other extremity: it is the *glottis* or opening of the windpipe. When the larynx is elevated, the epiglottis can be readily depressed so as to cover it completely.

The extremities of the arytenoid cartilages, and their appendices, may be recognised at the posterior edge of the glottis. At a short distance below this edge, the œsophagus begins.

The *Pharynx* is composed of the membrane continued from the nose and mouth internally, and of a stratum of muscular fibres externally. The internal membrane is very soft and flexible, and perforated by many muciferous ducts. The surface which it forms is rather rough, owing to the mucous gland which it covers. It has a red colour, but not so deep as that of some other parts. It is connected to the muscular stratum by a loose cellular membrane.

The muscular coat consists of three different portions, which are considered as so many distinct muscles.

The fibres of each of these muscles originate on each side, and run in an oblique direction to meet in the middle, thus forming the posterior external surface of the dissected pharynx.

The fibres of the upper muscle originate from the cuneiform process of the occipital bone, from the pterygoid processes of the os-sphenoides, and from the upper and lower jaws, near the last dentes molares, on each side. They unite in a middle line in the back of the pharynx.

The fibres of the middle muscle originate principally from the lateral parts of the os-hyoides, and from the ligaments which connect that bone to the thyroid cartilage. The superior fibres run obliquely upwards, so as to cover a part of the first mentioned muscle, and terminate in the cuneiform process of the occipital bone; while the other fibres unite with those of the opposite side in the middle line.

The fibres of the lower muscles arise from the thyroid and the cricoid cartilages, and terminate also in the middle line: those which are superior, running obliquely upwards; the inferior, nearly in a transverse direction.

It is obvious, from the origin and insertion of these fibres, that the pharynx must have the power of contracting its dimensions in every respect; and, particularly, that its diameter may be lessened at any place, and that the whole may be drawn upwards.

SYSTEM OF ANATOMY.

PART VII.

OF THE THORAX.

Before the thorax is described, it will be in order to consider the

Mammæ;

Or those glandular bodies situated on the anterior part of it, which, in females, are destined to the secretion of milk.

These glands lie between the skin and the pectoral muscles, and are attached to the surfaces of those muscles by cellular membrane.

They are of a circular form; and consist of a whitish firm substance, divisible into small masses or lobes, which are composed of smaller portions or lobuli. Between these glandular portions, a great deal of adipose matter is so diffused, that, it constitutes a considerable part of the bulk of the mammæ.

The gland, however, varies greatly in thickness in the same person at different periods of life.

The mammæ become much enlarged about the age of puberty. They are also very large during pregnancy and lactation; but after the period of child-bearing, they diminish considerably. They are supplied with blood by the external and internal mammary

arteries, the branches of which enter them irregularly in several different places.

The veins correspond with the arteries.

From the small glandular portions that compose the mamma, fine excretory tubes arise, which unite together and form the great lactiferous ducts of the gland. These ducts proceed in a radiated manner from the circumference to the centre, and terminate on the surface of the nipple.*

They are commonly about fifteen in number, and vary considerably in size: the largest of them being more than one-sixth of an inch in diameter.

They can be very readily injected by the orifices of the nipple, from a pipe filled with mercury, in subjects who have died during lactation or pregnancy; but they are very small in subjects of a different description.

It has been asserted by respectable anatomists, that these ducts communicate freely with each other; but they do not appear to do so: each duct seems to be connected with its proper branches only.†

Haller appears to have entertained the *remarkable sentiment*, that some of the ducts originate in the adipose matter about the gland, as well as in the glandular substance.‡

The papilla, or nipple, in which these ducts terminate, is in the centre of the mamma: it consists of a firm elastic substance, and is nearly cylindrical in form. It is rendered tumid by irritation, and by certain emotions.

The lactiferous ducts terminate upon its extremity. When it is elongated they can freely discharge their

* Described in the 16th century, by Charles Etienne, Vesalius and Posthius, but their uses were unknown.—Ed.

† See Edinburgh Medical Commentaries, vol. i. page 31.—a paper by Meckel.—Ed.

‡ Elementa Physiologiæ, Tom. 7, Pars II. page 7.

contents; but when it contracts, this discharge is impeded.

The skin immediately around the nipple is of a bright red colour in virgins of mature age. In pregnant women it is sometimes almost black; and in women who have borne children it is often brownish. It abounds with sebaceous glands, which form small eminences on its surface.

This gland exists in males, although it is very small. In boys, soon after birth, it has often been known to tumefy, and become very painful, in consequence of the secretion and accumulation of a whitish fluid, which can be discharged by pressure. It also sometimes swells and is painful, in males at the age of puberty.

There have been some instances in which it has secreted milk in adult males; and a few instances also in which it has been affected with cancer, in the same sex.

The mamma is plentifully supplied with absorbent vessels, which pass from it to the lymphatic glands in the axilla.

Its nerves are principally derived from the great plexus formed by the nerves of the arm.

CHAPTER I.

OF THE GENERAL CAVITY OF THE THORAX.

SECTION I.

Of the Form of the Cavity of the Thorax.

The osseous structure of the thorax is described in vol. i. page 102. The cavity is completed by the intercostal muscles, which close the vacuities between the ribs; and by the diaphragm, which fills up the whole space included within its lower margin.

If we except the apertures of the diaphragm, which are completely occupied by the aorta, the vena cava, and the œsophagus, &c., the only outlet of this cavity is above: it is formed by the upper ribs, the first dorsal vertebra, and the sternum. The figure of this aperture is between that of the circle and the oval; but it is made irregular by the vertebræ, and by the upper edge of the sternum.

When the superior extremities and the muscles appropriated to them are removed, the external figure of the thorax is conical; but the cavity formed by it is considerably influenced by the spine, which protrudes into it; while the ribs, as they proceed from the spine, curve backwards, and thus increase its prominency in the cavity.

The diaphragm has a great effect upon the figure of the cavity of the thorax. It protrudes into it from below, with a convexity of such form that it has been compared to an inverted bowl; so that, although it arises from the lower margin of the thorax, the central parts of it are nearly as high as the fourth rib.

The position of the diaphragm is also oblique. The anterior portion of its margin, being connected to the seventh and eighth ribs, is much higher than the posterior portion, which is attached to the eleventh and twelfth.

In consequence of the *figure* and *position* of the diaphragm, the form of the cavity of the thorax resembles that of the hoof of the ox when its posterior part is presented forwards.

SECTION II.

Of the Arrangement of the Pleuræ.

The thorax contains the two lungs and heart, as well as several very important parts of smaller size.

The lungs occupy the greatest part of the cavity; and to each of them is appropriated a complete sac, called *Pleura,* which is so arranged that it covers the surface of the lungs, and is continued from it to the contiguous surface of the thorax, which it lines. After covering the lung, it is extended from it to the spine posteriorly, and the sternum anteriorly: so that in tracing the pleura in a circular direction, if you begin at the sternum, it proceeds on the inside of the ribs to the spine; at the spine it leaves the surface of the thorax, and proceeds directly forwards towards the sternum. In its course from the spine to the sternum, it soon meets with the great branch of the windpipe and the blood vessels, which go to the lung: it continues on these vessels and round the lung until it arrives at the anterior side of the vessels, when it again proceeds forwards until it arrives at the sternum. Each sac being arranged in the same way, there is a part of each extended from the spine to the sternum. These two laminæ form the great vertical septum of the thorax, called *Mediastinum.* They are situated at some distance from each other; and

the heart, with its investing membrane or pericardium, is placed between them.

The pericardium is also a complete sac or bladder, which, after covering perfectly the surface of the heart, is extended from it so as to form a sac, which lies loose about it, and appears to contain it. This loose portion adheres to those parts of the laminæ of the mediastinum with which it is contiguous; and thus three chambers are formed within the cavity of the thorax: one for each lung, and one for the heart.

The two lamina of the pleura, which constitute the mediastinum, are at different distances from each other, in different places. At the upper part of the thorax, they approach each other from the internal edges of the first ribs; and, as these include a space which is nearly circular, the vacuity between these lamina is necessarily of that form, at its commencement above.

Here, therefore, is a space between them above, which is occupied by the great transverse vein that carries the blood of the left subclavian and the left internal jugular to the superior cava; by the trachea; by the œsophagus; and by the subclavian and carotid arteries, as they rise from the curve of the aorta. This space is bounded below by the above mentioned curve of the aorta.

The heart and pericardium are so placed that there is a small distance between them and the sternum: in this space the two lamina of the mediastinum are very near to each other; and cellular substance intervenes between them. This portion of the mediastinum is called the *Anterior Mediastinum.*

Posteriorly, the heart and pericardium are also at a small distance from the spine; and here the lamina of the mediastinum are at a greater distance from each other, and form a long narrow cavity which

extends down the thorax in front of the vertebræ: this is called the *Posterior Mediastinum.* It contains a considerable portion of the aorta as it descends from its curve, the œsophagus, the thoracic duct, and the vena azygos. The aorta is in contact with the left lamen, and can often be seen through it when the left lung is lifted up.

The œsophagus is in contact with the right lamen: in its progress downwards, it inclines to the left side and is advanced before the aorta.

The vena azygos appears posterior to the œsophagus; it proceeds upwards until it is as high as the right branch of the windpipe: here it bends forward, round that branch, and opens into the superior cava, before that vein opens into the right auricle.

The thoracic duct proceeds upwards from below, lying in the space between the aorta and the vena azygos, until the beginning of the curve of the aorta, when it inclines to the left, proceeding towards the place of its termination.

The formation of the mediastinum, and the arrangement of the pleura, as well as the connexion of these membranes with the parts contained in the thorax, may be studied advantageously, after the subject has been prepared in the manner now to be described.

Take away, from each side, the five ribs which are situated between the first and last true ribs, by separating their cartilages from the sternum, and their heads from the spine; so that the great cavities of the thorax may be laid open.

The precise course of the mediastinum is thus rendered obvious; and the sternum may now be divided with a saw throughout its whole length in the same direction; so that the division of the bone may correspond with the space between the lamina of the mediastinum.

Separate the portion of the sternum cautiously, so as to avoid lacerating the lamina of mediastinum; and keep them separate, while the trachea is dissected from the neck into the cavity of the thorax; the great trans-

verse vein and the descending cava are dissected to the pericardium; and the left carotid artery, with the right subclavian and carotid, are dissected to the curve of the aorta, taking care not to destroy the lamina of the mediastinum.

After this preparation the upper space between the lamina of the mediastinum can be examined, and the relative situation of the trachea and the great vessels in it can be understood. The anterior mediastinum can also be studied: the root of each lung, or its connexion with the mediastinum, may be seen perfectly; and the precise situation of the lung, in its proper cavity, may be well conceived.

After this, while the portions of the sternum are separated, the pericardium may be opened, and the heart brought into view: the attachment of the pericardium, and to the mediastinum, and to the diaphragm, may be seen with advantage in this situation. The portions of the sternum may now be detached from the ribs, with which they remain connected; and farther dissection may be performed to examine the posterior mediastinum and its contents, and the parts which constitute the roots of the lungs.

CHAPTER II.

OF THE HEART AND THE PERICARDIUM, AND THE GREAT VESSELS CONNECTED WITH THE HEART.

SECTION I.

Of the Pericardium.

The heart is enclosed by a membranous sac, which, upon a superficial view, seems only connected with its great vessels: but which, in fact, adheres closely to the whole of its surface. From this surface it is extended to those vessels; from which it proceeds, after the manner of the reflected membranes, and forms an enclosure that lies loosely about the heart. If it were dissected from the heart, without laceration or wounding, it would be an entire sac.

The pericardium, thus arranged, is placed between the two lamina of the mediastinum, and adheres firmly to them where they are contiguous to it; it also adheres firmly to the diaphragm below, and thus preserves the heart in its proper position.

The figure of the pericardium, when it is distended, is somewhat conical; the base being on the diaphragm. The cavity formed by it is larger than the heart after death, but it is probable, that the heart nearly fills it during life; for when this organ is distended by injection, it often occupies the whole cavity of the pericardium.

The pericardium is composed of two lamina, the internal of which covers the heart, as has been already described; while the external merely extends over the loose portion of the other, and blends itself

with the mediastinum, where that membrane invests the great vessels.

The internal surface of the pericardium is very smooth and polished; and in the living subject is constantly moistened with a fluid, which is probably effused from the exhalent vessels on its surface.

The quantity of this fluid does not commonly exceed two drachms; but in cases of disease it sometimes amounts to many ounces.* It is naturally transparent, but slightly tinged with red in children, and yellow in old persons. It is often slightly tinged with red in persons who have died by violence.

SECTION II.

Of the Heart.

THE great organ of the circulation consists of muscular fibres, which are so arranged that they give it a conical form, and compose four distinct cavities within it.

Two of these cavities, which are called *Auricles*, receive the contents of the veins; the other two communicate with the arteries, and are called *Ventricles.*

The auricles form the basis of the cone; the ventricles the body and apex.

The structure of the auricles is much less firm than that of the ventricles, and consists of a smaller proportion of muscular fibres. They appear like appendages of the heart, while the ventricles compose the body of the viscus.

The ventricles are very thick, and are composed of muscular fibres closely compacted.

* The pericardium has been so distended, by effusion in dropsy, that it has formed a tumour, protruding on the neck from under the sternum. This tumour had a strong pulsating motion. It disappeared completely when the other hydropic symptoms were relieved.

The figure of the heart is not regularly conical; for a portion of it, extending from the apex to the base, is flattened; and in its natural position, this flat part of the surface is downwards.

It is placed obliquely in the body; so that its base presents backward and to the right, and its apex forward and to the left.

Notwithstanding this obliquity, the terms right and left are applied to the different sides of the heart, and to the different auricles and ventricles; although they might, with equal propriety, be called anterior and posterior.

The two great veins called *Venæ Cavæ*, which bring the blood from every part of the body, open into the right auricle from above and below; the right auricle opens into the right ventricle; and from this ventricle arises the artery denominated *Pulmonary*, which passes to the lungs.

The *Pulmonary veins*, which bring back the blood from the lungs, open into the left auricle; this auricle opens into the left ventricle; and from this ventricle proceeds the *Aorta*, or great artery, which carries blood to every part of the body.

The heart is preserved in its position, 1st, by the venæ cavæ, which are connected to all the parts to which they are contiguous in their course; 2d, by the vessels which pass between it and the lungs, which are retained in a particular position by the mediastinum; 3d, by the aorta, which is attached to the mediastinum in its course downwards, after making its great curve; and 4th, by the pericardium, which is attached to the great vessels and to the mediastinum. By these different modes the basis of the heart is fixed, while its body and apex are perfectly free from attachment, and only contiguous to the pericardium.

The external surface of the heart, being formed by the pericardium, is very smooth: under this surface a large quantity of fat is often found.

The two auricles are contiguous to each other at the base, and are separated by a partition which is common to both.

The *Right Auricle* originates from the junction of the two venæ cavæ. These veins are united at some distance behind the right ventricle,* and are dilated anteriorly into a sac or pouch, which is called the *Sinus*, and extends to the right ventricle, to which it is united.

The upper part of this pouch, or sinus, forms a point with indented edges, which is detached from the ventricle, and lies loose on the right side of the aorta. This point has some resemblance to the ear of a dog, from which circumstance the whole cavity has been called *auricle;* but by many persons the cavity is considered as consisting of two portions: the *Auricle*, strictly speaking; and the *Sinus Venosus*, above described: they however form but one cavity.

This portion of the heart, or *Right Auricle*, is of an irregular oblong figure. In its posterior surface, it is indented; for the direction of the two cavæ, at their junction, is not precisely the same; but they form an angle, which causes this indentation. The anterior portion of the auricle, or that which appears like a pouch between the ventricle and the veins, is different in its structure from the posterior part, which is strictly a portion of the veins. It consists simply of muscular fibres, which are arranged in fasciculi that cover the whole internal surface: this is also the case with the point, or that part which is strictly called *auricle*.

* In this description the heart is supposed to be in its natural position.

These fasciculi are denominated *Musculi Pectinati*, from their resemblance to the teeth of a comb.

That part of the internal surface, which is formed by the septum is smooth, and the whole is covered by a delicate membrane.

On the surface of the septum, below the middle, is an oval depression, which has a thick edge or margin: this is called the *Fossa Ovalis*. In the fœtal heart, it was the *Foramen Ovale*, or aperture which forms the communication between the two auricles.

Near this fossa is a large semilunar plait, or valve, with its points and concave edge uppermost, and convex edge downwards. It was described by Eustachius, and therefore, is called the Valve of Eustachius.

Anterior to this valve, and near the union of the auricle and ventricle, is the orifice of the proper vein of the heart, or the conorary vein. This orifice is covered by another semilunar valve, which is sometimes reticulated.

The aperture, which forms the communication between the right auricle and right ventricle, is about an inch in diameter, and is called ostium venosum. From its whole margin arises a valvular ring, or duplicature of the membrane lining the surface: this circular valve is divided into three angular portions, which are called *Valvulæ Tricuspides*. From their margins proceed a great number of fine tendinous threads, which are connected to a number of distinct portions of muscular substance, which arise from the ventricle.

The *Right Ventricle*, when examined separately from the other parts of the heart, is rather triangular in its figure. It is composed entirely of muscular fibres closely compacted; and is much thicker than the auricle, although not so thick as the other ven-

tricle. Its internal surface is composed of bundles or columns of fleshy fibres, which are of various thickness and length. Some of these columns arise from the ventricle, and are connected with the tendinous threads, which are attached to the margin of the tricuspid valves: the direction of them is from the apex of the heart towards the base. Others of the columns arise from one part of the surface of the ventricle, and are inserted into another part. A third species are attached to the ventricle throughout their whole length, forming ridges or eminences on it. The columns of the two last described species are very numerous. They present an elegant reticulated surface when the ventricle is laid open, and appear also to occupy a considerable portion of the cavity of the heart, which some of them run acoss in every direction near the apex. They are all covered by a membrane continued from the auricle and the tricuspid valves; but this membrane appears more delicate and transparent in the ventricle than it is in the auricle.

A portion of the internal surface of the ventricle, which is to the left, is much smoother and less fasciculated than the rest: it leads to the orifice of the pulmonary artery, which arises from it near the basis of the ventricle. This artery is very conspicuous, externally, at the basis of the heart.

It is very evident, upon the first inspection of the heart, that the valvulæ tricuspides will permit the blood to flow from the auricle to the ventricle; but must rise and close the orifice, and thereby prevent its passage back again, when the ventricle contracts.

The use of the tendinous threads, which connect the valves to the fleshy columns, is also very evident; the valve is supported by this connexion, and prevented from yielding to the pressure and opening a passage into the auricle. The blood,

therefore, upon the contraction of the ventricle, is necessarily forced into the pulmonary artery; the passage to which is now perfectly free. Into this artery the membrane lining the ventricle seems continued; but immediately within the orifice of the artery, it is formed into three semi-circular folds, each of which adheres to the surface of the artery by its circumference, while the edge constituting its diameter is loose. In the middle of this loose edge is a small firm tubercle, called *Corpusculum Arantii*,* which adds to the strength of the valve. Each of these valves, by its connexion with the artery, forms a sack or pocket, the orifice of which opens forward towards the course of the artery, and the bottom of it presents towards the ventricle. Blood will, therefore, pass from the ventricle in the artery, and along it without filling these sacks; and, on the contrary, in this course, will compress them and keep them empty. If it moves in the artery towards the heart, it will necessarily fill these sacks, and press the semicircular portions, from the sides of the artery, against each other; by this means a partition or septum, consisting of three portions, will be formed between the artery and the heart, which will always exist when the artery compresses, (or acts upon,) its contents. It is demonstrable, by injecting wax into the artery, in a retrograde direction, that these valves do not form a flat septum, but one which is convex towards the heart, and concave towards the artery; and that this convexity is composed of three distinct parts, each of which is convex. At the place where these valves are fixed, the artery bulges out when distended by a retrograde injection. The enlargements thus produced are called the *Sinuses* of *Valsalva*, after the anatomist who first described them.

* After Arantius, a professor at Bologna, who first described it.

The valves are called *Semilunar*—and, although they are formed by a very thin membrane, they are very strong.

The *Left Auricle* is situated on the left side of the basis of the heart. It originates from the junction of the four pulmonary veins; two of which come from each side of the thorax, and appear to form a large part of it. It is nearly of a cubic form; but has also an angular portion, which constitutes the proper auricle, that proceeds from the upper and left part of the cavity, and is situated on the left side of the pulmonary artery.

This auricle is lined by a strong membrane, from which the valves between it and the ventricle originate; but it has no fleshy columns or musculi pectinati, except in the angular process properly called auricle.

These valves and the orifice communicating with the ventricle, resemble those which have been already described between the right auricle and ventricle; but with this difference, that the valvular ring is divided into two portions only, instead of three, which are called *Valvulæ Mitrales.* The tendinous threads, which are connected to the muscular columns, are also attached to these valves, as in the case of the right auricle.

These valves admit the passage of blood from the auricle into the ventricle, but completely prevent its return when the ventricle contracts. One of them is so situated that it covers the mouth of the aorta while the blood is flowing into the ventricle, and leaves that orifice open when the ventricle contracts, and the passage to the auricle is closed.

The *Left Ventricle* is situated posteriorly, and to the left of the *Right Ventricle.* Its figure is different, for it is rather conical, and it is also longer.

The internal surface of this ventricle resembles

that of the right ventricle: but the columnæ carneæ are stronger and larger.

On the right side of this ventricle is the mouth of the aorta. The surface of the ventricle near this opening is smooth and polished, to facilitate the passage of the blood.

The mouth of the aorta is furnished with three semilunar valves, after the manner of the pulmonary artery, but the former are stronger; the corpuscula Arantii are better developed in them. Indeed, Mr. Hunter does not admit of their existence in the pulmonary artery. The sinuses of Valsalva are about the same size in both arteries.

The cavity of this ventricle is supposed to be smaller than that of the right; but the amount of the difference has not been accurately ascertained.

This ventricle must have much more force than the right, as its parietes are so much thicker. Their thickness often exceeds half an inch.

The difference in the strength of the two ventricles probably corresponds with the difference between the extent of the pulmonary artery and the aorta.

The thickness of the septum between the ventricles is thicker than the sides or parietes of the right ventricle, and less thick than those of the left.

The muscular fibres of the heart are generally less florid than those of the voluntary muscles; they are also more closely compacted together. The direction of many of them is oblique or spiral; but this general arrangement is very intricate: it is such, however, that the cavities of the heart are lessened, and probably completely obliterated, by the contraction of these fibres.*

* Mr. Home has given a precise description of the muscular fibres of the heart in his Croonian Lecture. London Philosophical Transactions for 1795, part I. page 215.

The external surface of the heart is covered by that portion of the pericardium which adheres to it. Adipose matter is often deposited between this membrane and the muscular surface; being distributed irregularly in various places.

This membrane is continued from the surface of the ventricles over that of the auricles. When it is dissected off from the place of their junction, these surfaces appear very distinct from each other.

The *proper blood vessels* of the heart appear to be arranged in conformity to the general laws of the circulation, and are very conspicuous on the surface. There are two arteries which arise from the aorta immediately after it leaves the heart, so that their orifices are covered by two of the semilunar valves. One of these passes from the aorta between the pulmonary artery and the right auricle, and continues in a circular course in the groove between the right auricle and the right ventricle, and sends off its principal branches to the right side of the heart.

The other artery of the heart passes between the pulmonary artery and the left auricle. It divides into two branches: one, which is anterior, passes to a groove on the surface, corresponding to the septum between the two ventricles, and continues on it to the apex of the heart, sending off branches in its course; another, which is posterior and circumflex, passes between the left auricle and ventricle.

The great vein of the heart opens into the under side of the right auricle, as has been already mentioned: the main trunk of this vein passes for some distance between the left auricle and ventricle.*

* It was asserted by Vieussens, at an early period in the last century, and soon afterwards by Thebesius, a German Professor, that there were a number of small orifices in the texture of the heart, which opened into the different cavities on both sides of it.

This assertion of a fact so difficult to reconcile with the general principles of the circulation, was received with great hesitation: and although

From the course of these different vessels round the basis of the ventricles of the heart, they are generally called *Coronary Vessels:* the arteries are denominated, from their position, *Right and Left Coronary*.

The nerves of the heart come from the cardiac plexus, which is composed of threads derived from the intercostal or great sympathetic nerves, and the nerves of the eighth pair.

SECTION III.

Of the Aorta, the Pulmonary Artery and Veins, and the Venæ Cavæ; at their commencement.

THE two great arteries, which arise from the heart, commence abruptly, and appear to be extremely different in their composition and structure from the heart.

They are composed of a substance, which has a whitish colour, and very dense texture, and is very *elastic* as well as firm and strong.

When the pericardium is removed, these arteries appear to proceed together from the upper part of the basis of the heart: the pulmonary artery being placed

it was confirmed by some very respectable anatomists of the last century, it was denied by others. Some of the anatomists of the present day have denied the existence of these orifices, and some others have neglected them entirely.

The subject has lately been brought forward in the London Philosophical Transactions of 1798, Part I. by a very respectable anatomist, Mr. Abernethy, who states, that he has often passed a coarse waxen injection from the proper arteries and veins of the heart into all the cavities of that organ, and particularly into the *Left Ventricle. But it was only in subjects with diseased lungs that this was practicable.*

The existence of this communication between the coronary vessels and the great cavities of the heart seems therefore to be proved. The easy demonstration in such subjects is ingeniously referred by Mr. Abernethy, to the obstruction of the circulation in the lungs; and he regards the communication as a provision enabling the coronary vessels to unload themselves, when the coronary vein cannot discharge freely into the right auricle.

to the *left* of the aorta with the left auricle on the left side of it, and the right auricle on the right side of the aorta. The pulmonary artery arises from the most anterior, and left part of the basis of the right ventricle, and proceeds obliquely backwards and upwards; inclining gradually to the left side for about eighteen or twenty lines; when it divides into two branches which pass to the two lungs.

The aorta arises from the left ventricle, under the origin of the pulmonary artery, and immediately proceeds to the right, covered by that vessel, until it mounts up between it and the right auricle: it then forms a great curve, or arch, which turns backward and to the left, to a considerable distance beyond the pulmonary artery. In this course, it crosses the right branch of the pulmonary artery; and, turning down in the angle between it and the left branch, takes a position on the left side of the spine.

The course of this artery, from its commencement at the ventricle, to the end of the great curve or arch, is extremely varied.

The uppermost part of the curve is in the bottom of the chamber formed by the separation of the lamina of the mediastinum when they join the first rib on each side.

From this part of the curve three large branches go off, namely, one, which soon divides into the carotid and the subclavian arteries of the right side; a second, somewhat smaller, which is the left carotid; and a third, which is the left subclavian artery.

When the heart and its great vessels are viewed from behind, (after they have all been filled with injection; and the pericardium, mediastinum, and windpipe have been removed,) the aorta appears first, descending behind the other vessels; the pulmonary artery then appears, dividing so as to form an obtuse angle with its two great branches, each of which di-

vides again before it enters the lung to which it is destined.

Under the main trunk of the pulmonary artery is the left auricle: its posterior surface is nearly of a square form, and each of the pulmonary veins proceeds from one of its angles. These veins ramify in the substance of the lungs, at a very short distance from the auricle: the two uppermost of them are situated rather anterior to the branches of the pulmonary artery.

In this posterior view, the pulmonary vessels of the right side cover a great part of the right auricle, as it is anterior to them. The lower portion of the auricle, with the termination of the inferior cava is to be seen below them. Above them the superior cava appears; and in that part of it which is immediately above the right branch of the pulmonary artery, is the orifice of the vena azygos.

In its natural situation in the thorax, the superior cava is connected by cellular membrane to the right lamen of the mediastinum, and is supported by it. At a small distance below the upper edge of the sternum, it receives the trunk formed by the left subclavian and internal jugular vein, which passes obliquely across the sternum below its inner edge, in the upper space between the lamina of the mediastinum.

CHAPTER III.

OF THE TRACHEA AND THE LUNGS.

Although the principal part of the windpipe is situated in the neck above the cavity of the thorax, it is so intimately connected with the lungs, that it is necessary to describe them together.

SECTION I.

Of the Trachea.

Trachea is the technical name for the windpipe, or the tube which passes from the larynx to the lungs.

This tube begins at the lower edge of the cricoid cartilage, and passes down the neck in front of the œsophagus as low as the third dorsal vertebra, when it divides into two branches called *Bronchia*, one of which goes to the right and the other to the left lung, and ramifies very minutely in them.

There is in its structure a number of flat cartilaginous rings placed at small distances from each other, the edges of which are connected by membrane so that they compose a tube.

These cartilaginous rings are not complete, for they do not form more than three-fourths or four-fifths of a circle; but their ends are connected by a membrane which forms the posterior part of the tube.

They are not alike in their size or form; some of them are rendered broader than others, by the union of two or three rings with each other, as the uppermost. The lowermost also is broad, and has a form which is accommodated to the bifurcation of the tube. Their number varies in different persons, from fifteen to twenty.

These rings may be considered as forming a part of the first proper coat of the trachea; which is composed of them, and of an elastic membrane that occupies all the interstice between them; so that the cartilages may be regarded as fixed in this membrane.

A similar arrangement of rings exists in the great branches of the bronchia; but after they ramify in the lungs, the cartilages are no longer in the form of rings: they are irregular in their figures, and are so arranged in the membrane, that they keep the tube completely open. These portions of cartilage do not continue throughout the whole extent of the ramifications; for they become smaller, and finally disappear, while the membranous tube continues without them, ramifying minutely, and probably forming the air cells of the lungs.

This membrane is very elastic: the lungs are very elastic also; and it is probable that their elasticity is derived from this membrane.

On the inside of this coat of the trachea is an arrangement of muscular fibres, which may be called a *muscular coat.* It is best seen by peeling off or removing the internal coat, to be next described.

On the membranous part of the trachea, where the cartilaginous rings are deficient, these muscular fibres run evidently in a transverse direction: in the spaces between the cartilages their direction is longitudinal. There is some reason to doubt whether these longitudinal fibres are confined altogether to the spaces between the cartilaginous rings, and attached only to their edges, because there is a fleshy substance on the internal surface of the rings, which appears to be continued from the spaces between them.

The internal coat of the trachea is a thin and delicate membrane, perforated with an immense number

of small foramina, which are the orifices of mucous ducts.

On the surface of this membrane there is an appearance of longitudinal fibres which are not distributed uniformly over it, but run in fasciculi in some places, and appear to be deficient in others. These fasciculi are particularly conspicuous in the ramifications of the bronchia in the lungs.

On the posterior membranous portion of the trachea, where the cartilages are deficient, a considerable number of small glandular bodies are placed, which are supposed to communicate with the mucous ducts that open on the internal surface. If these bodies are removed from the external surface of this portion, and the muscular fibres are also removed from the internal, a very thin membrane only remains, which is very different from that which is left between the rings, when the fleshy substance is removed from that situation.

The reason of the deficiency in the rings, at this posterior part, is not very obvious.* It continues in the bronchia until the form of their cartilages is changed in the lungs: if it were only to accommodate the œsophagus, during the passage of food, there would be no occasion for its extension to the bronchia.

At the bifurcation of the trachea, and on the bronchia, are a number of black coloured bodies, which resemble the lymphatic glands in form and texture. They continue on the ramifications of the bronchia some distance into the substance of the lungs. Their number is often very considerable; and they vary in size from three or four lines in dia-

* Dr. Physick has advanced the opinion that it enables a person to expel the mucus of the lungs by contracting the size of the trachea, and consequently increasing the velocity or impetus of the air.—*Ed.*

meter to eighteen or twenty. As lymphatic vessels have been traced to and from them during their course to the thoracic duct, they are considered as lymphatic glands.

SECTION II.

Of the Lungs.

There are two of these organs: each of which occupies one of the great cavities of the thorax.

When placed together, in their natural position, they resemble the hoof of the ox, with its back part forward; but they are at such a distance from each other, and of such a figure, that they allow the mediastinum and heart to intervene; and they cover every part of the heart anteriorly, except a small portion at the apex.

Each lung fills completely the cavity in which it is placed, and every part of its external surface is in contact with some part of the internal surface of the cavity; but when in a natural and healthy state, it is not connected with any part except the lamina of the mediastinum. One great branch of the trachea and of the pulmonary artery passes from the mediastinum to each lung, and enters it at a place which is rather nearer to the upper rib than to the diaphragm, and much nearer to the spine than the sternum: at this place also the pulmonary veins return from the lungs to the heart.

These vessels are enclosed in a membrane, which is continued over them from the mediastinum, and extended from them to the lung. Thus covered, they constitute what has been called the *Root of the Lung.*

When their covering, derived from the mediastinum, is removed, the situation of these vessels appears to be such that the bronchia are posterior, the

branches of the pulmonary artery are rather above and before, and the veins below and before them.

Each of these vessels ramifies before it enters into the substance of the lungs: the bronchia and the branches of the pulmonary artery send each a large branch downward to the inferior part of the lungs, from which the lower pulmonary veins pass in a direction nearly horizontal. In general, each of the smaller ramifications of the bronchia in the lungs is attended by an artery and a vein.

Each lung is divided, by very deep fissures, into portions which are called *Lobes*. The right lung is composed of three of these lobes, and the left lung of two.

The lungs are covered, as has been already stated, with the reflected portion of the pleura continued from the mediastinum, which is very delicate and almost transparent. They have, therefore, a very smooth surface, which is kept moist by exudation from the arteries of the membrane.

The *Colour of the Lungs* is different in different subjects. In children they are of a light red colour; in adults they are often of a light gray; owing to the deposition of a black pigment in the substance immediately under the membranes which form their external surface. Their colour is often formed by a mixture of red and black. In this case they are more loaded with blood, and the vessels of the internal membranes being distended with it, the red colour is derived from them.

The black pigment sometimes appears in round spots of three or four lines in diameter: under the external membrane it is often in much smaller portions, and sometimes is arranged in lines in the interstices of the lobuli, to be hereafter mentioned. It is also diffused in small quantities throughout the substance of the lungs.

The source of this substance, and the use of it, are unknown.

The lungs are of a soft spongy texture; and, in animals that have breathed, they have always a considerable quantity of air in them.

They consist of cells, which communicate with the branches of the trachea that ramify through them in every part. These cells are extremely small, and the membranes which compose them are so thin and delicate, that if they are all filled by an injection of wax, thrown into the trachea, the whole cellular part of the lung will appear like a mass of wax. If a corroded preparation be made of a lung injected in this manner with force, the wax will appear like a concretion.

These effects of injections prove that the membranes of which the cells are formed are very thin; and, of course, that their volume is very small when compared with the capacity of the cells.

In those corroded preparations, in which the ramifications of the bronchia are detached from the wax of the cells, these ramifications become extremely small indeed.

If the lungs of the human subjects, or of animals of similar construction, be examined when they are inflated, their cellular structure will be very obvious, although their cells are so small that they cannot commonly be distinguished by the naked eye. Each of the extreme ramifications of the bronchia appears to be surrounded by a portion of this cellular substance, which is gradually distended when air is blown into the ramification.

This cellular substance is formed into small portions of various angular figures, which are denominated *Lobuli*: these can be separated to a considerable extent from each other. They are covered by the proper coat of the lungs, which is extremely delicate,

and closely connected to the general covering derived from the pleura. Between the lobuli, where they are in contact with each other, there is a portion of common cellular substance, which is easily distinguished through the membrane covering the lungs. This is very distinct from the cellular structure which communicates with the ramifications of the bronchia, and contains air; for it has no communication with the air, unless the proper coat of the lungs be ruptured. If a pipe be introduced by a puncture of the external coat of the lungs, and this interstitial cellular membrane be inflated, it will compress the lobuli. This cellular membrane is always free from adipose matter: it may be easily examined in the lungs of the bullock.

Upon the membranes which compose the air cells, the pulmonary artery and vein ramify most minutely; and it seems to have been proved within the last thirty years, by the united labours of chemists and physiologists, that the great object of respiration is to effect a chemical process between the atmospheric air, when taken into the air cells, and the blood which circulates in these vessels.

In addition to the blood vessels which thus pass through the substance of the lungs, there are several smaller arteries denominated *Bronchial,* which arise either from the upper intercostal, or from the aorta itself: they pass upon the bronchia, and are distributed to the substance of the lungs. The veins which correspond with these arteries terminate ultimately in the vena azygos.

The nerves of the lungs are small in proportion to the bulk of these organs. They are derived principally from the par vagum and the intercostal nerves.

The elasticity of the air cells of the lungs and of the ramifications of the bronchia which lead to them, appears by their rapid contraction after distention,

and by the force with which they expel the air which is used to inflate them when taken out of the thorax.

The Thorax of the Fœtus.

In the cavity between the lamina of the mediastinum, where they approach each other from the first ribs, is situated a substance which is denominated the

Thymus Gland.

This substance gradually diminishes after birth, so that in the adult it is often not to be found: and when it exists it is changed in its texture, being much firmer, as well as greatly diminished.

In the fœtus it is of a pale red colour; and during infancy it has a yellowish tinge. It generally extends from the thyroid gland, or a little below it, to the pericardium. From its superior portion two lateral processes are extended upwards: below, it is formed into two lobes, which lie on the pericardium.

If an incision be made into its substance, a fluid can be pressed out, which has a whitish colour, and coagulates upon the addition of alcohol.

Although it is called a *gland*, no excretory duct has ever been found connected with it.

The blood vessels of this body are derived from the thyroid branches of the subclavians, from the internal mammaries, and the vessels of the pericardium and mediastinum.

The Heart,

And the great arteries which proceed from it, have some very interesting peculiarities in the fœtus.

In the septum between the two auricles, is a foramen of sufficient size to permit the passage of a large quill, which inclines to the oval form, with its longest diameter vertical when the body is erect. On the *left* side of the septum, a valve, formed by the lining membranes, is connected to this foramen; and allows

a free passage to a fluid moving from the right auricle to the left; but prevents the passage of a fluid from the left to the right. This structure is evidently calculated to allow some of the blood which flows into the right auricle from the two venæ cavæ to pass into the left auricle of the heart, instead of going into the right ventricle. As the contents of the left auricle pass into the left ventricle, and from thence into the aorta, it is obvious that the blood, which passes from the right auricle into the left through these foramen, must be transmitted from the system of the vena cava to the system of the aorta, without going through the lungs, as it must necessarily do in subjects who do not enjoy the fœtal structure.

The Pulmonary Artery and the Aorta

Have a communication in the fœtus, which is very analogous to the communication between the auricles of the heart.

From the pulmonary artery, where it divides into the two great branches, another large branch continues, in the direction of the main trunk, until it joins the aorta; with which it communicates at a small distance below the origin of the left subclavian artery. In the young subject that has never respired, it appears as if the pulmonary artery was continued into the aorta, and sent off in its course a branch on each side, much smaller than itself, to each lung. In subjects that have lived a few days, these branches to the lungs are much larger; and then the main pulmonary artery appears to have divided into three branches: one to each lung, and one to the aorta; but that which continues to the aorta is larger than either of the others.

In the course of time, however, this branch of the aorta is contracted, so that no fluid passes through it;

and it has the appearance of a ligament, in which state it remains.

The course of the blood from the right ventricle, through the pulmonary artery, to the aorta below its curve, is more direct than that from the left ventricle to the same spot, through the aorta at its commencement. The column of blood in the aorta below its curve is evidently propelled by the force of both ventricles: and this circumstance, although it seems to proceed merely from the state of the fœtal lungs, is particularly calculated for the very extensive circulation which the fœtus carries on, by means of the umbilical arteries and vein in the placenta.

The Lungs of the Fœtus

Differ greatly from those of the adult. They appear solid, as if they were composed of the parenchymatous substance which constitutes the matter of glands, rather than the light spongy substance of the lungs of adults. They differ also in colour from the lungs of older subjects, being of a dull red.

They have greater specific gravity than water; but if air be once inspired, so much of it remains in them that they ever afterwards float in that fluid.

The nature of the process of respiration, and its effects upon the animal economy, particularly upon the action of the heart, appear to be much better understood at this time than they were before the discovery of the composition of the atmosphere, by Dr. Priestley and by Mr. Scheele. The publications upon this subject, which have appeared since that period, namely, 1774, are therefore much more interesting to the student of medicine than those which preceded them. Two of these publications ought to be particularly noticed by him; namely, an essay, by Dr. Edward Goodwyn, entitled, "The Connexion of Life

with Respiration;"—and the "Physiological Researches of M. Bichat upon Life and Death. Part Second.*

The general doctrines respecting the oxygenation or decarbonization of the blood, and the absolute necessity that it should take place to a certain degree in order to preserve life, are confirmed by a number of cases of malformation of the heart or the great vessels, in which the structure was such that a considerable portion of venous blood passed from the right side of the heart to the aorta, without going through the lungs. In these different cases, notwithstanding the structure was somewhat varied, the symptoms produced were very much alike; differing in the respective patients in degree only, and not in kind.

The symptoms indicating this structure, are blue colour of the face, (such as generally accompanies suffocation,) extending more or less over the whole body, and particularly apparent under the nails of the fingers and toes; anxiety about the region of the heart; palpitation; laborious respiration; sensations of great debility, &c.: all of which are greatly aggravated by muscular exertion. These effects have generally appeared to be proportioned to the quantity of venous blood admitted into the aortic system.†

When these appearances take place immediately after birth, it is probable that they depend entirely upon malformation of the heart or great vessels; but when they commence at a subsequent period, they are

* The student will derive much information respecting the publications on this subject, prior to 1804, from Dr. Bostock's Essay on Respiration.—Since the publication of that essay several interesting papers on respiration have appeared, namely, Two Memoires by the late Abbe Spalanzani;—"An Inquiry into the Changes induced on Atmospheric Air by the Germination of Seeds," &c., by Ellis;—two very important communications by Messrs. Allen and Pepys in the Transactions of the Royal Society of London for 1808 and 1809;—and "Farther Inquiries into the Changes induced on Atmospheric Air." Also by Ellis.

† Cases of this kind are related in several of the periodical publications on medical subjects. Two of them were described by the late Dr. William Hunter in the sixth volume of Medical Observations and Inquiries, by a Society of Physicians in London; one, (quoted by Dr. Goodwyn,) is in the Observationes Anatomicæ of Sandifort; and another, by Dr. J. S. Dorsey, has lately been published in the first number of the New England Journal of Medicine and Surgery.

commonly the effect of a diseased alteration in the lungs. They sometimes occur near the termination of fatal cases of pneumonia or catarrh; but a different cause, which has not latterly been suspected, appears to have produced them in the following case, related by Dr. Marcet, in the first volume of the Edinburgh Medical and Physical Journal.

The blue colour occurred in a young woman, twenty-one years of age, in whom it had never been observed before. It came on during an affection of the breast, and was attended with great prostration of strength and difficulty of breathing; as well as cough, œdema of the hands and feet, and several other symptoms. About seven weeks after the commencement of these symptoms, she died; when it was ascertained by dissection, *that there was no unnatural communication whatever between the cavities of the heart, and that its valves were all in a perfect and natural state.* The lungs were free from tubercles, or any other appearance of disease. Their substance seemed *more compact* than usual, especially the left lung, although it did not sink in water; *but they adhered every where to the inner surface of the thorax, to the diaphragm, and to the pleura covering the pericardium.*—This case is the more remarkable, because numberless instances have occurred, in which very large portions of the external surface of the lungs have been found, upon dissection, to adhere to the internal surface of the thorax, without the occurrence of such symptoms during life.

It may be inferred, from a statement published by M. Dupuytren, in a late volume of the Proceedings of the National Institute of France, that the oxygenation or decarbonation of the blood is much affected, in respiration, by an influence exercised by the nerves which are appropriated to the lungs. From his account it appears, that although the complete division of the eighth pair of nerves produces death after some time; yet in the horse, whose nerves are thus divided, life continues, and respiration goes on, from half an hour to ten hours; but his arterial blood is in a state of great disoxygenation or carbonation during this time. This fact is more remarka-

ble, because venous blood, contained in a bladder exposed to the open air, will become oxygenated or decarbonated.

It is also asserted in another Memoir, read to the National Institute by Dr. J. M. Provençal; that animals, in whom the eighth pair of nerves has been divided, do not consume so much oxygen, or produce so much carbonic acid, by a considerable degree, as they did before the division of these nerves; and that their temperature is considerably reduced.*

The effect, that venous blood occasions death, when it is admitted into the left ventricle of the heart, and the aorta, is truly important. Dr. Goodwin explained it by suggesting that this blood was not sufficiently stimulating to produce the necessary excitement of the heart; but on this occasion one of his friends proposed to him the following question: Why does venous blood affect the left side of the heart in this injurious manner, when it appears to exert no noxious effects whatever on the right side of that organ? His reply may be seen in a note at the 82d page of his Essay, in the first edition. Bichat has offered a solution which completely resolves this difficulty, viz. "The effect of venous blood upon the heart is produced by the presence of this blood in the proper, or coronary arteries of that organ, and not in its great cavities." For the animation of the heart, like that of the other parts of the body, depends upon the state of the blood in the arteries which penetrate its texture.† And while the heart acts, the blood of the coronary arteries will be the same with that of the left ventricle.— See Bichat's Researches, P. II. art. 6, § 2.

The French anatomists appear to entertain some peculiar opinions respecting the course of the blood in the fœtus, which have a particular relation to the subject last mentioned. Winslow, who paid great attention to the valve of Eustachius in the right auricle of the heart, was of opinion, that this valve was cal-

* These Memoirs are republished in the Eclectic Repertory of Philadelphia for April and October, 1811.

† It is probable that the contents of the great cavities of the heart have no more effect upon its animation than the contents of the stomach and bowels have upon the animation of those organs.

culated for some important purpose in the fœtal economy.* Although his hypothesis respecting its particular use has not been retained by his countrymen, many of them have adopted his general sentiment; and among others Sabatier. That learned anatomist believed that this valve, in the fœtal state, serves *to direct the blood of the inferior cava, after its arrival in the right auricle through the foramen ovale into the left auricle; while the blood of the upper cava passes directly into the right ventricle.* His opinion seems to be supported to a certain degree,

1. By the direction in which the two columns of blood enter the auricles from the two vena cavæ.

2. By the position of the Eustachian valve.

3. By the foramen ovale, when its valve is complete; as the passage through it from the right to the left, is at that time oblique, and from below upwards.

The theory of Sabatier appears to be this:—the umbilical vein brings from the placenta blood which has a quality essential to the animation of the fœtus. If there were no particular provision to the contrary, a large portion of this blood, after passing from the umbilical vein by the inferior cava into the right auricle of the heart, would proceed by the right ventricle through the pulmonary artery and arterial canal, into the aorta, below the origins of the carotid and subclavian arteries; and consequently none of it would pass to the head and upper extremities, but a considerable part would return again by the umbilical arteries to the placenta, without circulating through the body: while, on the other hand, the blood which passed by the carotid and subclavian arteries to the head and upper extremities returning from them to the heart by the superior cava, might pass from the right auricle to the left auricle and ventricle and the aorta, and so to the head and upper extremities again, without passing through the placenta. But by means of this valve, the blood of the lower cava, and of course of the umbilical vein, is directed to the left auricle and ventricle and the aorta, by which a considerable portion of it will necessarily pass to the head and upper extremities: while the blood which returns from these

* See Memoirs of the Academy of Sciences for 1717 and 1725.

parts by the superior cavâ, must consequently pass from the right auricle into the right ventricle and pulmonary artery; from whence a large portion of it will proceed through the arterial canal into the aorta beyond the carotids and subclavians, and of this portion a considerable part will go to the placenta by the umbilical arteries. Sabatier compares the course of the blood in the fœtus to the course of a fluid in a tube which has the form of the numeral character 8.* —If this doctrine be true, the progress of the blood in the fœtus and placenta is very analogous to that of the double circulation of the adult; the character 8 answering equally well in the description of either subject.

According to Sabatier, the blood of the placenta takes this peculiar course through the heart, in order that some of it may be carried to the head and upper extremities. But an additional reason may be suggested, which appears to be of great importance; namely, the supplying of the coronary or *proper* vessels of the heart with some of the same blood.

The heart of the adult, as has been before stated, cannot act without its proper or coronary arteries are supplied with arterial blood. The heart of the fœtus performs a more extensive circulation than that of the adult, and, therefore, is probably in greater need of such blood. But *unless the blood of the placenta pass through the foramen ovale into the left auricle and ventricle, and so to the aorta, it cannot enter the coronary arteries which originate at the commencement of the aorta;* for the blood which flows from the right side of the heart through the arterial canal, passes into the aorta at so great a distance from the orifices of the coronary arteries, that it certainly cannot enter them.

The whole of this doctrine seems to be supported by a fact very familiar to accoucheurs, viz. the occurrence of death in the fœtus whenever the circulation through the umbilical cord is suspended during fifteen or twenty minutes; for as the placenta imparts to the fœtal blood a quality essential to life, some arrangement seems necessary to provide for the equal distribution of the blood which comes from this organ, and

* See Sabatier's Paper on this subject, in the Memoirs of the Academy of Sciences, for 1774.

especially for carrying the requisite proportion of it to the substance of the heart.

Life has existed for some time with a structure very different indeed from that which is natural. In the series of elegant engravings relating to morbid anatomy, published by Dr. Baillie, is the representation of a heart, in which the vena cavæ opened into the right auricle, and the pulmonary veins into the left auricle, in the usual manner; but the aorta arose entirely from the right ventricle, and the pulmonary artery as completely from the left. The canalis arteriosus, however, passed from the pulmonary artery to the aorta, and the foramen ovale existed. In this case, it is evident, that the pulmonary artery must have carried back to the lungs the arterial blood which came from them by the pulmonary veins, with a small quantity of venous blood that passed into the left auricle through the foramen ovale; and that the aorta must have returned to the body, the venous blood which just before had been brought from it by the venæ cavæ, with a small addition of arterial blood that passed through the ductus arteriosus. Yet with this structure the child lived two months after its birth.

A case, which had a strong resemblance to the foregoing, occurred lately in Philadelphia, and was examined by the author of this work. The vena cavæ terminated regularly in the right auricle, and the pulmonary veins in the same regular manner in the left; but the pulmonary artery arose from the left ventricle, aud the aorta from the right. *There was no communication between these vessels by a canalis arteriosus;* but a large opening existed in the septum between the auricles.

It is very evident, that, in this case also the pulmonary artery must have returned to the lungs the arterial blood as it came from them, and the aorta must have carried back to the general system the venous blood brought to the heart by the cavæ; excepting only those portions of the arterial and venous blood which must have flowed reciprocally from one auricle into the other, and thus changed their respective situations.

The subject was about two years and a half old. The heart was nearly double the natural size, and the foramen, or opening in the septum between the auricles, was eight or nine lines in diameter. The pulmonary artery was larger in proportion than the aorta or the heart.

With this organization, the child lived to the age above specified. His countenance was *generally* rather livid; and this colour was always much increased by the least irregularity of respiration. His nails were always livid. He sometimes appeared placid, but more frequently in distress. He never walked, and seldom, if ever, stood on his feet. When sitting on the floor, he would sometimes push himself about the room; but this muscular exertion always greatly affected his respiration. He attained the size common to children of his age, and had generally a great appetite. For some weeks before death his legs and feet were swelled.

It is probable that the protraction of life depended upon the mixture of the blood in the two auricles; and that they really were to be considered as one cavity, in this case.

There seems reason to believe, that in adults of the common structure, there is no passage of blood from one auricle to the other, when the foramen ovale has remained open; because in several persons in whom it was found by dissection to have remained open, there were no appearances during life, that indicated the presence of disoxygenated blood in the aortic system. It is probable, that the small size of the foramen ovale, the valvular structure which generally exists there, and the complete occupation of the left auricle by the blood flowing from the pulmonary veins, prevent the passage of blood from the right auricle to the left, in such persons; whereas, in the case in question, the opening between the auricles was very large indeed, and there was no appearance of a valve about it.

Although it be admitted, that in adults with the foramen ovale pervious, there is no transmission of

blood from the right to the left auricle; there is every reason to believe, that this transmission goes on steadily in the fœtus. To the arguments derived from the structure and the nature of the case, it may be added, that the pulmonary veins, in the fœtal state, carry to the left auricle a quantity of blood, not sufficient to fill it; while the venæ cavæ carry to the right auricle, not only the whole blood of the body, but of the umbilical cord and placenta: some of which must flow into the unfilled left auricle, when the right auricle becomes fully distended.

The question, how far the functions of the heart and lungs are dependent upon the brain, is very important, and has often been agitated with great zeal. In favour of the opinion that the motions of the heart are independent of the brain, may be stated the numerous cases in which the brain has been deficient in children, who have notwithstanding lived the full period of utero-gestation, and even a short time after birth, and have arrived at their full size, with every appearance of perfect vigour and action in the heart. In support of the doctrine, that the action of the heart is immediately dependent upon the brain, it may be observed, that no organ of the body appears to be so much influenced by passions and other mental affections as the heart. These contradictory facts have occasioned this question to be considered as undecided, if not incapable of solution; although Cruikshank and Bichat* have stated circumstances very favourable to the opinion that the motions of the heart are independent of the brain.

This question seems now to be settled by the experiments of Dr. Legallois, a physician of Paris,

* See Cruikshank's Experiments on the Nerves and Spinal Marrow of living Animals; London Philosophical Transactions for 1795. The eighth experiment has a particular relation to this subject. Bichat's Researches, part 2, article 9. The Abbe Fontana has considered this subject in his Treatise on the Venom of the Viper, vol. ii. page 194, English translation; and also in some of his other works.

which prove, that in animals who have suffered *decapitation*, the action of the heart does not cease as an immediate consequence of the removal of the head; but its cessation is an *indirect effect*, induced by the suspension of respiration. That respiration is immediately affected by decapitation, and depends upon the influence of the brain transmitted through the eighth pair of nerves. That the action of the heart will continue a long time after decapitation, if inflation of the lungs, or artificial respiration, be performed; but, on the contrary, if the spinal *marrow* be destroyed, the action of the heart ceases irrecoverably.

The inference from these experiments seems very conclusive, that the *Spinal Marrow*, and not the brain, is the source of the motions of the heart.

It appears also by some of the experiments, that the power of motion in the *trunk* of the body, is derived from the spinal marrow; and that, when this organ is partially destroyed, the parts which receive nerves from the destroyed portion soon cease to live. By particular management of the spinal marrow, one part of the body can be preserved alive for some time after the other parts are dead.

These experiments of Dr. Legallois commenced in 1806 or 1807, and were communicated to the Imperial Institute of France, in 1811. The committee of that body, to whom they were referred, namely, Messrs. Humboldt, Hallé, and Percy, reported that the experiments had been repeated before them, at three different meetings of several hours each; and that, to allow themselves sufficient time for reflection, they suffered an interval of a week to take place between the meetings. The committee believe these experiments to have proved,

1st. That the principle upon which all the movements of inspiration depend, has its seat about that part of the medulla oblongata from which the nerves of the eighth pair arise.

2d. That the principle which animates each part of the trunk of the body, is seated in that portion of the spinal marrow from which the nerves of the part arise.

3. That the source of the life and strength of the heart is also in the spinal marrow; not in any distinct portion, but in the whole of it.

4th. That the great sympathetic nerve is to be considered as originating in the spinal marrow, and that the particular character of this nerve is to place each of the parts to which it is distributed under the immediate influence of the whole nervous power.

The interesting memoir of Dr. Legallois is confirmed to a certain degree by a communication of B. C. Brodie to the Royal Society of London in 1810, in which are detailed many very interesting experiments which induced the author to conclude,—

That the influence of the brain is not directly necessary to the action of the heart; and

That when the brain is injured or removed, the action of the heart ceases, only because *respiration* is under its influence; and if, under these circumstances, respiration is artificially produced, the circulation will still continue.

These various experiments apply particularly to the cases in which the brain is deficient. The effects of mental agitations on the heart are likewise reconcilable to the theory which arises out of them. But they throw no light on the question why the motions of the heart are so perfectly free from the influence of the will: and although they seem to prove incontestably that the motion of the heart is independent of the brain, it ought to be remembered that in certain diseased states of the brain, where that organ appears to be compressed, the action of the heart is often very irregular, and its contractions less frequent than usual.

SYSTEM OF ANATOMY.

PART VIII.

OF THE ABDOMEN.

The lowermost of the two great cavities of the trunk of the body is called *Abdomen.* The pelvis may be considered as a chamber of this cavity, although its structure is very different.

CHAPTER I.

A GENERAL VIEW OF THE ABDOMEN AND PELVIS AND THEIR CONTENTS, WITH AN ACCOUNT OF THE PERITONEUM.

SECTION I.

Of the Abdomen.

This great cavity occupies more than half of the space enclosed by the ribs, and all the interior of the trunk of the body below the thorax.

It is formed by the diaphragm, supported by the lower ribs; by a portion of the spine; by the various muscles which occur between the lower margin of the thorax and the upper margin of the ossa innominata: and by the ossa innominata, which contribute, for the purpose, the costæ of the ossa ilia, as well as the pelvis.

The general figure of this cavity partakes of the figure of the lower part of the trunk of the body; with these exceptions, that the diaphragm makes it arched or vaulted above, that the spine and psoæ muscles, &c. are rather prominent on the posterior surface, and that the lower part corresponds with the costæ of the ossa ilia and with the pelvis.

To acquire a precise idea of this cavity, it is necessary first to study the bones concerned in its structure, in their natural situation in the skeleton; and then the muscles, which form so large a part of it.

The arrangement of the tendons of some of these muscles, with a view to complete the cavity, is particularly interesting; as that of the external oblique where it forms the crural arch.* The ligaments of the pelvis and the levatores ani muscles, as they also contribute to the formation of the cavity, and have an influence upon its figure, should likewise be attended to.

In the walls of the cavity, thus constructed, there are many foramina by which the viscera and other contained parts communicate externally; but few of them pass directly into the cavity; for, like the thorax, there are no vacuities in it exterior to the contained organs.

Three of these foramina are in the diaphragm. One for the transmission of the aorta, another for the vena cava, and a third for the œsophagus. Below, there is an aperture at each of the crural arches, for the transmission of the great femoral vessels; in each of the ligamentous membranes, which close the foramen thyroideum, for the obturator vessels and nerve; and at the sacro sciatic notches, for nerves and blood vessels.

* See the account of this tendon, vol. i. in the description of the "Obliquus Descendens Externus."

There are also two apertures at the bottom of the pelvis, for the orifice of the rectum and of the urethra. In the tendons of the external oblique muscles are two orifices, covered by the integuments, for the spermatic cords; and, in the fœtal state, one for the umbilical cord.

The apertures in the tendons, and under their edges, for the transmission of the spermatic cords, and the blood vessels, &c. are not be considered as simple perforations made abruptly; but the edges of these foramina are formed by tendinous membranes turned inwards and continued so as to compose a cylindrical tube, which becomes gradually so thin that it cannot be readily distinguished from the cellular membrane with which it is connected.* The blood vessels, &c. pass along this tube before they go through the apertures.

It is evident from the construction of this cavity, that it is essentially different from the thorax. It has no power of spontaneous dilatation whatever: it yields passively to the distention of the stomach and intestines, during deglutition, and when air is extricated from the aliment, &c.; but it is particularly calculated for compressing its contents by the contraction of the muscles which compose it. The diminution of its capacity, which is thus effected, not only takes place to a great degree, but occasionally with great force. The diaphragm and the abdominal muscles may be considered in some measure as antagonists of each other. When the diaphragm descends, if the abdominal muscles are passive, they are distended by the contents of the abdomen, which are forcibly pressed from above: but if the abdominal muscles act at the same time, an effort to diminish the cavity in every

* The student of anatomy, when engaged with this subject, will be gratified by the examination of Mr. Astley Cooper's plates relating to herniæ.

direction takes place, and the contained parts are compressed with more or less force according to the exertion made. This will be very evident upon examining the situation of the diaphragm and of the abdominal muscles. When their force is considered, it will also be very obvious that the various outlets of the cavity are constructed most advantageously; otherwise hernia or protrusion of its contents would be a daily occurrence.

The abdomen contains, 1st. *The Stomach and the whole Intestinal Tube,* consisting of the small and the great intestines.

2d. *The Assisting Chylopoietic Viscera,*—the Liver, the Pancreas and the Spleen.

3d. *The Urinary Organs,*—the Kidneys, the Ureters, and the Bladder. To which should be added the Glandulæ Renales.

4th. *The Organs of Generation* in part: those of the female sex being almost wholly included in the pelvis; and those of the male being situated partly within and partly without it.

5th. *The Peritoneum* and its various processes. The Mesentery, Omentum, &c.

6th. *A portion of the Aorta, and almost the whole of the Inferior Cava,* and their great ramifications: with such of their branches as are appropriated to the Viscera of the Abdomen and Pelvis.

7th. *Those portions of the Par Vagum and Intercostal Nerves* which are appropriated to the cavity; and portions of some of the nerves destined to the lower extremities.

8th. *The lower part of the Thoracic Duct,* or the Great Trunk of the Absorbent System, with the large branches that compose it, and the glands connected with them: and also those absorbent vessels called *Lacteals,* and their glands.

As the cavity of the abdomen has no natural divi-

sions, anatomists have divided it by imaginary lines into various regions, with a view to precision in their accounts of the situation of the different contained parts. Thus,

They have, very generally, agreed to apply two transverse lines to form three great divisions; viz. the *Upper*, *Middle* and *Lower:* and they have also agreed that each of these divisions shall be subdivided into three regions.

The three regions of the uppermost division are defined with some precision. Those on each side, which are called the *Right* and *Left Hypochondriac regions*, occupy the spaces immediately within the lower ribs and their cartilages; while the middle space, included within the margins of these cartilages, and a line drawn from the lower edge of the thorax on one side to that on the other, is denominated the *Epigastric region.*

The boundaries of the regions below are less precisely defined.

Many anatomists have fixed the two transverse lines above mentioned at an arbitrary distance above and below the umbilicus: some choosing for this purpose two inches, and others a hand's breadth. As these distances will occupy different proportions of the cavity in persons of different stature, other anatomists, with a view to avoid this inconvenience, have proposed to connect these lines with certain fixed points of the skeleton.

It is of importance that the boundaries of these regions should be fixed, and therefore the proposition of Sabatier may be adopted; namely, To draw the upper transverse line from the most inferior part of the lower margin of the thorax, on one side, to the corresponding part on the opposite side; and the lower transverse line from the uppermost part of the spine

of one ilium to the same part of the other. These lines will mark the three great divisions. If, then, two parallel lines are drawn directly upwards, one from each of the superior anterior spinous processes of the ilium until it touches the lower margin of the thorax, they will divide each of the two lower divisions of the abdomen into three regions. The centre of the middle division is the umbilical, and on each side of it is the right and left lumbar region. The middle of the lower division is the hypogastric; and on each side of it the right and left iliac region.

It is true, that the three middle regions of the abdomen will be made very small by the vicinity of the transverse lines to each other; but the advantages derived from a principle which is similar in its application to all subjects, fully compensates for this inconvenience.

There are therefore nine of these regions; namely, The Epigastric and the two Hypochondriac: the Umbilical, and the two Lumbar: the Hypogastric, and the two Iliac regions.* And it should be added, that the space immediately around the end of the sternum is sometimes called the *Scrobiculus Cordis;* and the space immediately within the os pubis, the *Regio Pubis.*

These different regions are generally occupied in the following manner: The liver fills nearly the whole of the right hypochondriac region, and extends through the upper part of the epigastric region into the left hypochondriac. The stomach occupies the principal part of the epigastric region, and a considerable portion of the left hypochondriac. The spleen is also situated in the left hypochondriac region.

* It is to be observed that the lateral regions of the middle and lower divisions of the abdomen are named differently by different writers.

That portion of the intestinal tube, which is composed of small intestines, is generally found in the umbilical, the hypogastric, and the iliac regions; and when the bladder is empty, in the pelvis. But the duodenum, or first of the small intestines, which proceeds immediately from the stomach, is situated in the epigastric and umbilical regions. The great intestine commences in or near the right iliac region, and ascends through the right lumbar to the right hypochondriac region. It then crosses the abdomen, passing through the lower part of the epigastric, or upper part of the umbilical to the left lumbar region: from this it continues into the left iliac region, and curves in such a manner that it finally arrives at the middle of the upper part of the os sacrum, when it descends into the pelvis, and, partaking of the curvature of the last mentioned bone, continues to the termination of the os coccygis.

In the back part of the epigastric region, and very low down in it, is situated the pancreas. The kidneys lie in the most posterior parts of the lumbar regions, and from each of them is continued a tube or duct, called *Ureter*, that passes into the pelvis to convey the urine to the bladder. This viscus, in males, is in contact with the last portion of the great intestine called the *Rectum*, and with it occupies almost all the cavity of the pelvis; while in females, the uterus and its appendages are situated between this intestine and the bladder.

In the posterior part of the abdomen, in contact with the spine, is the aorta. This great blood vessel passes from the thorax between the crura of the diaphragm, and continues down the spine until it approaches towards the pelvis, when it divides into two great branches called the *Iliac Arteries*. Each of these great branches divides again, on the side

of the pelvis, into two; namely, the *External Iliac*, which passes under the crural arch to the thigh, and the *Internal Iliac*, or *Hypogastric*, which descends into the cavity of the pelvis.

Soon after the arrival of the aorta in the abdomen it gives off two large branches. The first, which is called the *Cœliac*, is distributed to the liver, the stomach, and the spleen: the second, called the *Superior Mesenteric*, is spent upon the intestines. Lower down in the abdomen, it also sends off a small branch for the intestines, called *Inferior Mesenteric*. Besides these vessels for the chylopoietic viscera, the aorta sends off a large branch, called *Emulgent*, to each kidney.

The inferior or ascending vena cava is situated on the right of the aorta, in front of the spine. It is formed below by the union of the iliac veins, and in its progress upwards, it receives the emulgent veins, which correspond to the arteries of the kidneys; but it receives in its course no veins which correspond directly with the cœliac and mesenteric arteries. The smaller veins, that answer to the branches of these arteries, unite and form one large vein, which goes to the liver, and is called (from the part of that viscus at which it enters,) *Vena Portarum*. From the liver three large veins pass into the vena cava, and deposite there the blood of the vena portarum, after it has furnished materials for the secretion of bile. The vena cava, in its passage upwards, is in close contact with the posterior thick edge of the liver: it often passes along a deep groove in this edge, and sometimes it is completely surrounded by the liver in its course. The veins of the liver enter the vena cava at this place, and of course they are not to be seen without dissection. Immediately after leaving the liver, the vena cava passes through an aperture in the tendinous

centre of the diaphragm to unite itself to the right auricle of the heart.

SECTION II.

Of the Peritoneum.

The abdomen, thus constructed and occupied, is lined by a thin firm membrane called *Peritoneum,* which is extremely smooth on its internal surface, and is immediately connected with the cellular substance exterior to it. This membrane adheres closely to the anterior, lateral, and superior portions of the surface of the abdomen; and is extended from the posterior surface so as to cover, more or less completely, the viscera of the cavity. Those viscera which are in close contact with the posterior surface of the abdomen, as some portions of the large intestine are covered only on their anterior surfaces, and are fixed in their precise situation by the peritoneum; which extends from them to the contiguous surface of the cavity, and adheres where it is in contact, so as to produce this effect.

Other viscera, which are not in close contact, but moveable to a distance from the posterior surface of the abdomen, are covered by this membrane, which is extended to them from the surface; and this extended portion forms an important part of the connexion between the viscus and the cavity in which it lies. This connecting part is called *Mesentery,* when it thus passes to the small intestines; *Mesocolon,* when it goes to the colon, one of the larger intestines; and *Ligament,* when it passes to some of the other viscera.

The peritoneum is a complete but empty sac, which is fixed in the abdomen anterior to the viscera. The anterior portion of this sac forms the lining to the anterior and lateral parts of the surface of the abdomen:

the posterior portion covers the viscera, and forms the mesentery, mesocolon, and ligaments above described.

It necessarily follows that the mesentery and the other similar processes are mere plaits or folds of the sac, which invests the viscera; and that they must consist of two lamina; and as the blood vessels, nerves, and absorbents, are all posterior to the peritoneum, they naturally pass between these lamina of the mesentery.

Some of the viscera are much more completely invested with the peritoneum than others. The stomach, liver, and spleen are almost completely surrounded by it; and it is said to form a coat for each of these viscera. That portion of the smaller intestinal tube, which is called *jejunum* and *ileum*, and the transverse portion of the large intestine, called the *arch of the colon*, are invested by it in the same way. But a considerable portion of the duodenum and the pancreas is behind it. The lateral portions of the colon are in close contact with the posterior surface of the abdomen, and the peritoneum only covers that portion of their surfaces which looks anteriorly towards the cavity of the abdomen, and is not in contact with its posterior surface.

The urinary organs are not much connected with the peritoneum. The kidneys appear exterior to it, and behind it: the bladder of urine is below it, and has but a partial covering from it, on its upper portion.

The peritoneum, which covers the stomach, is extended from the great curvature of that organ so as to form a large membrane, which descends like an apron before the intestines. This process of peritoneum is composed of two lamina, so thin and delicate as to resemble cellular membrane, which, after extending downwards to the lower part of the addomen,

are turned backwards and upwards, and proceed in that direction until they arrive at the colon, which they enclose, and then continue to the back of the abdomen, forming the mesocolon. The part of this process which is between the stomach and the colon, is called *Epiploon* or *Omentum*.

This extension of a membrane, from the surface of a cavity which it lines, to the external surface of a viscus in that cavity, is called, by some anatomists, "reflection;" and the technical term *reflected membrane* is therefore applied to a membrane distributed like the peritoneum.

It must be evident that this distribution of the peritoneum is very complex, and that it is not easy to form an accurate conception of it from description, but it can be readily understood by demonstration; therefore no farther account of its arrangement will now be attempted, but each of its processes will be considered with the organs to which they are particularly subservient.

That portion of the peritoneum which lines the abdomen, and covers the viscera, is thin and delicate, but very firm. It yields to distention, as in pregnancy, ascites, &c., and again recovers its dimensions. It was formerly thought to be composed of two lamina, but this cannot be proved. The internal surface of this membrane is very smooth, and highly polished; and from it exudes a liquor which is well calculated for lubrication, and barely sufficient to keep the surface moist during health; but sometimes it is very abundant, and occasions the aforesaid disease—ascites. This fluid appears to exude from the surface of the peritoneum when it is compressed in a living animal, or in one recently dead. It is probably effused from the extremities of arteries, for an effusion takes place when water is injected into these vessels.

The peritoneum abounds with absorbent vessels,

and therefore possesses the power of absorption to a great degree. This power may be inferred, not only from the spontaneous removal of the fluid of ascites, but if milk and water be introduced into the abdomen of a living animal, through a puncture, it will also disappear.

The blood vessels of the peritoneum are derived from those which supply the neighbouring parts. Nerves have not yet been traced into it, and it has little or no sensibility.

This membrane supports the viscera of the abdomen in their proper situations; and also forms a surface for them, and for the cavities which contain them, so smooth and lubricated, that no injury can arise from their friction.

The cellular substance, by which the peritoneum is connected to the contiguous parts, is very different in different places. It is very short indeed between this membrane and the stomach and intestines, and also between it and the tendinous centre of the diaphragm. Between the peritoneum and the muscles generally, it is much longer. When it covers the kidneys and the psoas muscle, it is very lax and yielding. About the kidneys a large quantity of adeps very commonly collects in it. On the psoas muscle it yields with but little resistance to the passage of pus, or any other effused fluid, as in the case of the psoas abscess.

CHAPTER II.

OF THE ŒSOPHAGUS, THE STOMACH, AND THE INTESTINES.

SECTION I.

Of the Œsophagus.

The Œsophagus is a muscular tube which passes from the pharynx to the stomach, and is so intimately connected with the stomach, that it will be advantageous to the student to attend to its structure immediately before he engages in the examination of that important organ.

The pharynx has been lately described* as composed of a varied stratum of muscular fibres, lined by a membrane which is continued from the internal surface of the nose and mouth. From the pharynx the œsophagus passes downwards between the trachea and the vertebræ. After the bifurcation of the trachea, it proceeds in contact with the spine, between the lamina of the mediastinum, to the diaphragm, which it passes through, and then terminates in the stomach.

The œsophagus is a flexible tube, which, when distended, is nearly cylindrical. It consists of a muscular coat externally, and an internal tunic evidently continued from that of the pharynx. These coats are connected by a cellular substance called the *Nervous Coat,* which is remarkably loose, and allows them to move considerably upon each other. The muscular coat, which is very distinguishable from that of the pharynx, consists of two substantial strata of fibres;

* See page 87.

the exterior of which is nearly longitudinal in its direction, and the interior circular or transverse.

The internal coat of the œsophagus, resembling that of the fauces, is soft and spongy. It is covered with a very delicate cuticle, which Haller supposed to be too tender to confine the matter of variolous pustules, as he had never found these extending into the œsophagus. It is very vascular, and abounds with the orifices of mucous follicles, from which is constantly poured out the mucus that is spread over this surface. When the œsophagus is not distended, many longitudinal plaits are found in this membrane by the contraction of the circular or transverse fibres exterior to it. These plaits are calculated to admit readily of the distention which is requisite in deglutition. This tunic is continued from the lining membrane of the pharynx above, and terminates below in the villous coat of the stomach; from which, however, it is very different.

The blood vessels of the œsophagus come from those which are in the vicinity. The nerves are derived from the eighth pair. The lymphatic vessels are very abundant.

In the neck the œsophagus inclines rather to the left of the middle line. As it proceeds down the back between the lamina of the mediastinum, it preserves the same course to the fourth dorsal vertebra, when it assumes the middle portion and proceeds downwards, with the aorta to its left, and the pericardium before it. About the ninth dorsal vertebra it inclines again rather to the left, and somewhat forward, to arrive at the aperture in the diaphragm through which it passes.

Throughout this course it is connected by cellular membrane to the contiguous parts; and this investiture of cellular membrane has been called its *External Coat.*

While the œsophagus is in the posterior mediastinum it is in contact with several small absorbent glands, especially when it first assumes a situation to the right of the aorta. These glands were formerly believed to be particularly connected with this tube, but they are now considered as belonging to the absorbent system. They are sometimes greatly enlarged.

SECTION II.

Of the Stomach.

This most important organ, which occasionally exerts a powerful influence upon every part of the body, appears very simple in its structure.

It is a large sac, which is so thin when much inflated, that at first view it seems membranous, but upon examination is found to be composed of several lamina or coats, each of a different structure. It is of considerable length, but incurvated. It is much larger at one extremity than the other, and changes so gradually in this respect, that it would appear conical, if it were straight. It is not, however, strictly conical, unless it is greatly distended; for when moderately distended, a transverse section is rather oval than circular. It is, therefore, considered as having two broad sides or surfaces, and two edges, which are the curvatures. It has been compared by the anatomists of different nations to the wind sac of the musical instrument called the bagpipe.* The orifice in which the œsophagus terminates is at a small distance from its largest extremity, and is called *Cardia*. The orifice which communicates

* The student ought not to attempt to acquire an idea of the form of the stomach without demonstration, for a view of one moment will be more serviceable than a long description.

with the intestines is at the termination of its small incurvated extremity, and is called the *Pylorus.*

The two ends of the stomach being thus very different in size, are denominated the great and small extremities. The two curved portions of the surface are also called the great and small curvatures. The two flat portions of the surface, or the broadsides, are called the anterior and posterior surfaces.

The situation of the stomach in the abdomen is nearly transverse: it lies principally in the left hypochondriac and epigastric regions, immediately below the liver. The great extremity of the stomach is in the left hypochondriac region, and the lesser extremity in the epigastric region, under the left lobe of the liver. The upper orifice, or *Cardia*, is nearly opposite to the body of the last dorsal vertebra; and owing to the curved form of the stomach, the other orifice, or *Pylorus*, is situated at a small distance to the right of that bone, and rather lower and more forward than the cardia: both orifices being in the epigastric region. The position of the stomach is oblique in two respects; it inclines in a small degree from above downwards, from the left to the right; and it also inclines downwards and forwards, from behind. Its two orifices are situated obliquely with respect to each other; for, if the stomach, when placed with its small curvature upwards, were divided into two equal parts by a vertical plane passing lengthways through it, they would be found on different sides of the plane.

As the œsophagus terminates in the stomach immemediately after it has passed through an aperture of the diaphragm, it is evident that the stomach must be somewhat fixed at that place; but it is more moveable at its other orifice; for the extremity of the duodenum, into which it is continued, is moveable.

The stomach is connected to the concave surface

of the liver by the reflexion or continuation of the peritoneum which forms the lesser omentum. This membrane, after extending over each surface of the stomach, continues from its great curve in the form of the large omentum, and connects it to different parts, especially to the colon. There are likewise folds of the peritoneum, as it passes from the diaphragm and from the spleen to the stomach, which appear like ligaments.

Notwithstanding these various connexions, the stomach undergoes considerable changes in its position. When it is nearly empty, and the intestines are in the same situation, its broad surfaces are presented forwards and backwards; but when it is distended, these surfaces are presented obliquely upwards and downwards, and the great curvature forwards. When its anterior surface is presented upwards, its orifices are considerably influenced in their direction, and the œsophagus forms an angle with the plane of the stomach.

The stomach is composed of four dissimilar lamina, which may be demonstrated by a simple process of dissection.

There is first a coat or external covering continued from the peritoneum: within this, and connected to it by delicate cellular substance, is a coat or stratum of muscular fibres: contiguous to these fibres, internally, is a layer of dense cellular substance, called a nervous coat; and last is the internal coat of the stomach, called villous or fungous, from the structure of its surface.

The external or first coat of the stomach, as has been already stated, is continued from the concave surface of the liver to the lesser curve of the stomach in two delicate lamina, which separate when they approach the stomach, and pass down, one on each side

of it, adhering firmly to it in their course: at the opposite curve of the stomach they again unite to form the great omentum. The stomach is therefore closely invested by the peritoneum on every part of its surface except two strips, one at the lesser and the other at the greater curvature. These strips or uncovered places are formed by the separation of the lamina above mentioned, which includes a triangular space bounded by the stomach and these two lamina. In these triangular spaces, at each curvature of the stomach, are situated the blood vessels which run along the stomach in those directions, and also the glands which belong to the absorbent vessels of this viscus. The peculiar arrangement of the lamina at this place is particularly calculated to permit the dilatation of the stomach. When it is dilated, the lamina are in close contact with its surface, and the blood vessels being in the angle formed by the adhesion of the two lamina to each other, are so likewise: when it contracts, the blood vessels appear to recede from it, and the lamina are then applied to each other.

Where the peritoneum thus forms a coat to the stomach, it is stronger and thicker than it is between the liver and stomach. In a recent subject it is very smooth and moist, but so thin that the muscular fibres, blood vessels, &c. appear through it. If it is carefully dissected from the muscular coat, it appears somewhat flocculent on that surface which adhered to the muscular fibres. It seems to be most abundantly furnished with serous vessels; but it has been asserted by Mascagni and Soemmering, that a large proportion of its texture consists of absorbent vessels. The cellular substance which connects this to the muscular coat appears no way different from ordinary cellular membrane.

The *Muscular Coat* of the stomach has been de-

scribed very differently by respectable anatomists; some considering it as forming three strata or fibres, and others but two. If the stomach and a portion of the œsophagus attached to it be moderately distended with air, and the external coat carefully dissected away, many longitudinal fibres will appear on every part of it, that evidently proceed from the œsophagus: these fibres are particularly numerous and strong on the lesser curvature of the stomach.—Beside the longitudinal fibres, there are many that have a circular direction, and these are particularly numerous towards the small extremity; but it has been doubted whether there are any fibres in the muscular coat of the stomach that go directly round it. The whole surface of the stomach, when the peritoneal coat is removed, appears at first view to be uniformly covered by muscular fibres; but upon close examination, there are interstices perceived, which are occupied with firm cellular membrane.

In contact with the internal surface of the muscular coat is the *cellular stratum,* which has been called the *Nervous Coat* of the stomach. It is dense and firm, of a whitish colour, resembling condensed cellular membrane. It was considered as different from ordinary cellular membrane; but if air be insinuated into its texture, by blowing between the muscular and villous coats, while it connects them to each other, it exhibits the proper appearance of cellular substance. It, however, adds greatly to the general strength of the stomach, and the vessels which terminate in the villous coat ramify in it.

The internal coat of the stomach in the dead subject is commonly of a whitish colour, with a tinge of red. It is named villous, from its supposed resemblance to the surface of velvet. It has also been called fungous, because the processes analogous to the villi

are extremely short, and its surface has a granulated appearance; differing in these respects from the internal surface of the intestines. It is continued from the lining membrane of the œsophagus, but is very different in its structure. Many very small vessels seem to enter into its texture, which are derived from branches that ramify in the nervous coat. It is supposed by several anatomists of the highest authority, to have a cuticle or epithelium; and it is said that such a membrane has been separated by disease. It ought, however, to be remembered, that the structure of the villous coat of the stomach and intestines, is essentially different from the structure of the cuticle.

The internal coat of the stomach is generally found covered, or spread over with mucus, which can be readily scraped off. This mucus is certainly effused upon it by secreting organs, and it has been supposed that there were small glandular bodies exterior to the villous coat, which furnished this secretion; but the existence of such bodies is very doubtful, as many skilful anatomists have not met with any appearance that could be taken for glands, except in a very few instances, which would not be the case if those appearances had been natural. Pores, perhaps the orifices of mucous follicles, and also of exhalent vessels, are very numerous, but no *proper* glandular masses are attached to them. Glands, as has been already said, are found in the triangular spaces between the lamina of the peritoneum at the great and small curvatures of the stomach, but these evidently belong to the absorbent system. Besides the mucus above mentioned, a large quantity of a different liquor, the proper *Gastric Juice,* or fluid of the stomach, is effused from its surface. It has been supposed that this fluid is furnished by the small glandular bodies believed to exist between the coats of this organ; but,

admitting the existence of these glands, they are not sufficiently numerous to produce so much of it as is found, and it is therefore probable that this fluid is discharged from the orifices of exhalent vessels in the internal surface.

Much information respecting the gastric liquor has been obtained within a few years past by the researches of physiologists, and they are generally agreed that it is the principal agent in the effects produced by the stomach upon alimentery substances.*

As the muscular coat of the stomach frequently varies its dimensions, the villous and nervous coats, which have no such power of contraction, cannot exactly fit it. They therefore generally appear larger, and of course are thrown into folds or rugæ. These folds are commonly in a longitudinal direction; but at the orifices of the stomach they are arranged in a radiated manner, and sometimes they are observed in a transverse direction. They depend upon the contraction of the muscular fibres, and disappear entirely when the stomach is laid open and spread out.

At the lower orifice is a circular fold, which is permanent, and constitutes the valve denominated *Py-*

* On this subject, the student may consult with advantage—

M. Réamur. In the Memoires of the Academy of Sciences for 1752.

John Hunter. London Philosophical Transactions for 1772; and also his Observations on the Animal Economy, 1786.

Dr. Edward Stevens. Inaugural Thesis de Alimentorum Concoctione. Edinburgh, 1777.

The Abbe Spalanzani. Dissertations relative to Natural History, &c. The first volume of the English translation contains the author's dissertations on digestion, and also the first paper of Mr. Hunter, and the Thesis of Dr. Stevens, as well as an account of the experiments of Mr. Gosse of Geneva.

In addition to these, there are several interesting essays in the French, German, and Italian languages, a compilation of which is to be found in Johnson's "History of the Progress and present State of Animal Chemistry." See Vol. I. page 188.

lorus. It appears like a circular septum with a large foramen in its centre, or like a flat ring. The villous and nervous coats of the stomach contribute to this, merely by forming the circular fold or ruga; and within this fold is a ring of muscular fibres, evidently connected with the circular fibres of the muscular coat of the stomach, the diameter of which at this place is not larger than that of an intestine: the fibres of this ring seem a part of the muscular coat projecting into the cavity of the stomach and duodenum. If a portion of the lesser extremity of the stomach and the adjoining part of the duodenum be detached, and laid open by a longitudinal incision, and then spread out upon a board, the internal coat can be very easily dissected from the muscular, and the pylorus will then appear like a ridge or narrow bundle of muscular fibres, which runs across the extended muscular membrane. It is evident that when the parts are replaced so as to form a cylinder, this narrow fasciculus will form a ring in it. Thus arranged, the circular fibres can readily close the lower orifice of the stomach.

The pylorus separates the stomach from the intestine duodenum; and this separation is marked exteriorly by a small circular depression, which corresponds exactly with the situation of the pylorus.

The arteries of the stomach are derived from the *Cœliac*, the first branch which the aorta sends off to the viscera of the abdomen. This great artery, immediately after it leaves the aorta, is divided into three branches, which are distributed to the stomach, the liver, and the spleen, and are called the *Superior Coronary* or *Gastric*, the *Hepatic* and the *Splenic*. Besides the first mentioned branch, which is distributed principally to the neighbourhood of the cardia and to the lesser curvature, the stomach receives a considerable branch from the hepatic, which passes along the

right portion of its great curvature, and has been called the right gastro-epiploic, and another from the spleen, which passes along the left portion of the great curvature, and has been called the left gastro-epiploic. In addition to these branches, the splenic artery, before it enters the spleen, sends off several small arteries to the great extremity of the stomach, which are called vasa brevia.

These vasa brevia generally arise from the main trunk of the splenic artery, but sometimes from its branches.

The veins which receive the blood from these arteries have similar names, and pursue corresponding courses backwards; but they terminate in the vena portarum.

The absorbent vessels of the stomach are very numerous and large: they pass to the glands which are on the two curvatures, and from thence to the thoracic duct. It is an important fact relative to the history of digestion, that there are good reasons for doubting whether chyle commonly passes through them, notwithstanding their number and size.*

The nerves of the stomach are derived principally from the two great branches of the par vagum, which accompany the œsophagus and are mostly spent upon this organ. It also receives branches from several plexuses, which are derived from the splanchnic portions of the intercostal nerves.

SECTION III.

Of the Intestines.

The intestines form a continued canal from the pylorus to the anus, which is generally six times

* Sabatier, however, in one subject observed white lines on the stomach, which he suspected to be lacteals. See his account of the absorbents of the stomach.

the length of the subject to which they belong. Although the different parts of this tube appear somewhat different from each other, they agree in their general structure. The coats or lamina of which they are composed, are much like those of the stomach, but the peritoneum which forms their external coat does not approach them in the same manner; nor is it continued in the form of omentum from the whole tube, there being only a certain portion of intestine, viz. the colon, from which such a process of peritoneum is continued.

The *Muscular Coat*, like that of the stomach, consists of two strata, the exterior of which is composed of longitudinal fibres, which adhere to the external coat, and do not appear very strong. The other stratum, consisting of circular or transverse fibres, is stronger, as the fibres are more numerous. It is observable that they adhere to the longitudinal fibres; and they seldom, if ever, form complete circles.

The cellular substance immediately within the muscular fibres resembles the nervous coat of the stomach in its firmess and density. It is likewise so arranged as to form many circular ridges on its internal surface, which support to a certain degree the permanent circular plaits of the internal coat, called valvulæ conniventes.

The inner surface of the internal coat has been commonly compared to that of velvet, and the coat is therefore called villous; but there is certainly a considerable difference between these surfaces; for if a portion of the small intestine be inverted, and then suspended in perfectly transparent water, in a clear glass, and examined with a strong light, it will appear like the external surface of the skin of a peach, on which the down or hair-like processes are not so close as those on velvet. On this surface, between

the villi, there are many orifices of mucous follicles and of exhaling vessels.* Exterior to the villous coat, many very small glandular bodies are sometimes found, which are called after their describers Glandulæ Brunneri and Peyeri.

The internal coat of the upper portion of the interstitial tube is arranged so as to form a great number of transverse or circular folds or plaits, called *Valvulæ Conniventes*, which do not generally extend round the intestine, but are segments of circles; they are so near each other, that their internal edges, which are very moveable, may be laid upon the folds next to them, like tiles or shingles. It is evident that this arrangement of the internal coat must add greatly to its length. This coat is extremely vascular, so that in the dead subject it can be uniformly coloured by a successful injection. The minute structure of it has been the subject of very diligent inquiry. There can be no doubt but that an immense number of exhaling and of absorbent vessels open upon it; but there are many different opinions respecting the termination of one set of vessels and the commencement of the other.

A very interesting account of the *Villous Coat* was published in 1744, by Lieberkuhn, who was considered by his contemporaries as a most expert practical anatomist, and was also very skilful in microscopical examinations, for which he was particularly calculated, as his natural powers of vision were uncommonly strong. In his essay he refers to his preparations, which were at Berlin, and which appear to have ex-

* It appears clearly, from the account of Lieberkuhn, that the orifices or terminations of the arteries on the intestines, are distinct from the follicles; for he forced injection from the arteries into the cavity of the intestines, and found the follicles still filled with mucus. He then urged the injection further, and filled the follicles, or forced the mucus out of them.

cited great surprise in the minds of the members of the Academy of Sciences of Prussia, at a time when one of the first anatomists of Europe, the celebrated Meckel, was of their number.

According to this account the internal surface of the small intestines abounds with villi, and with the orifices of follicles. These villi, are about the fifth part of a line in breadth. In each of them is a cavity filled with a soft spongy substance, which has one or more orifices communicating with the intestines, and from which also proceeds a lacteal vessel. On the membrane which forms this cavity, blood vessels are most minutely ramified. This cavity he calls an ampullula, and supposes it to constitute the principal part of the villus. By injecting the arteries of the intestine, he was able to pass a fluid through the ampullula into the cavity of the gut; he kept a stream of air in this way passing through the ampullula until it was nearly dry and stiff, and then laid it open with a fine instrument. From the appearances which then presented, he inferred that the cavity of the ampullula was occupied with a spongy or cellular substance. Around each villus he found a number of mucous follicles, which often were filled with a tenacious mucus: and distinct from these must be the exhalent orifices, which discharged a fluid injected by the arteries without passing through the mucous follicles.

Lieberkuhn died early, and left but one essay on this subject, which was originally published in Holland, in 1744, but has been republished by the Academ of Berlin, in their Memoirs; and also by Mr. John Sheldon, of London.

This account of Lieberkuhn appears to have been admitted by Haller: but it has been rigidly scrutinized by some of the anatomists of London, who were

particularly interested with the subject; as they had paid great attention to the absorbent system, and were very successful in the investigation of it.

The late Mr. Hewson, whose opinion is entitled to the greatest respect, rejected the idea of the ampullula, and believed that the villi are composed of networks of lacteals, as well as arteries and veins; although he added that "this is the only circumstance concerning these parts in which he should differ from this very acute observer."*

Mr. Sheldon agrees with Lieberkuhn: but Mr. Cruikshank asserts, that, "in some hundred villi, he has seen the lacteals originate by radiated branches, whose orifices were distinct on the surface of the villus." The villus being transparent, when the intestine was immersed in water, these branches, filled with chyle, could be seen passing into the lacteal. Mr. Cruikshank therefore supposes that Lieberkuhn was mistaken, and that the spongy cavity, or ampullula, was the common cellular membrane, connecting together all the arteries, veins, nerves, and lacteals.

It seems probable, from Mr. Cruikshank's statement, that Dr. William Hunter held the same opinion with himself. And there is also reason to believe that Monro the second, who studied anatomy at Berlin, held a different opinion from Lieberkuhn.

Mr. Fyfe, who has been much employed in the investigation of the absorbent system, and must be perfectly acquainted with the preparations of Monro, asserts that each lacteal takes its rise upon one of the villi by numerous short radiated branches, and each branch is furnished with an orifice for imbibing chyle.

Several of the late French writers adopted the opi-

* See Hewson's Experimental Inquiries, vol. 2, page 171.

nion of Lieberkuhn; but his countryman Soemmering gives a different account of the subject. He says, that, besides the blood vessels, each villus consists of a fine net-work of absorbent vessels, whose orifices may be distinctly recognised; and that from six to ten of these orifices are sometimes discovered.

Mascagni, who has published the most extensive work upon the absorbent system that has yet appeared, supposes Lieberkuhn to have been mistaken, and confirms the description of Hewson: but he also agrees with Hewson in his opinion of the general accuracy of Lieberkuhn.

Notwithstanding their differences respecting the origin of the lacteals, all these observers have agreed, that the orifices which communicate with the lacteals are on the villi; and that these villi contain also very fine ramifications of blood vessels. They have also agreed that the surface of the intestines in the intervals of the villi seems occupied with the orifices of ducts or of exhalent vessels.*

Division of the Intestines.

Although there is a considerable degree of uniformity in the structure of the intestinal canal, different parts of it are very distinguishable from each other by their exterior appearance, by their size, their investments, and their position.

The first division is into two great portions, which are very different from each other in their diameter and length, as well as their situation: the first portion being much smaller in diameter, and near four times the length of the other.

* On this subject the student will consult with advantage, Hewson's Experimental Inquiries, vol. 2; Sheldon's History of the Absorbent System, part 1st; Cruikshank on the Anatomy of the Absorbing Vessels; and the Historia Vasorum Lymphaticorum Corporis Humani, of Mascagni.

These portions are therefore known by the names of *Great and Small Intestines*, and the line of separation between them is very strongly marked; for they do not gradually change into each other, but the alteration in size and in exterior appearance is very abrupt, and their communication is not perfectly direct. A considerable portion of the *Great Intestine* is fixed immoveably in the abdomen, while a large part of the *Small Intestine* is very moveable.

Each of these great portions of the intestinal tube is subdivided into three parts. Thus, in the *Small Intestine*, there is a piece at the commencement called *Duodenum*, a great part of which has no coat from the peritoneum, and is immoveably fixed in one situation; while all the remainder of the small intestine has a uniform covering from the peritoneum, and is very moveable. This last piece, notwithstanding its exterior uniformity, is considered as forming two parts. The uppermost two-fifths from one part, which is called *Jejunum;* and the remainder is called *Ileum*. The *Great Intestine* commences in the lower part of the right side of the abdomen, and after proceeding up that side, crosses over to the left, along which it descends to the lower part again, when by a peculiar flexure it proceeds to the centre of the posterior margin of the pelvis, from which it passes down to the anus. A short portion of this intestine, which is above its junction with the ileum, is called *Cæcum;* the part which proceeds from this, round the abdomen, is called *Colon;* and the portion which is in the pelvis is called *Rectum*.

Of the Small Intestines.

Previous to the description of the small intestines, it is necessary to observe, that the *Mesocolon*, or process of the peritoneum connected to the transverse portion of the colon, forms a kind of moveable and

incomplete septum, which divides the abdomen into an upper and lower apartment. Above this septum are the stomach, with the commencement of the duodenum, the liver, and the spleen; below it, that portion of the small intestine which is called jejunum and ileum, makes its appearance. The portion of the intestine which passes from the stomach to the jejunum, and is called *Duodenum*, is so much involved by the mesocolon, that the greatest part of it cannot be seen without dissecting the mesocolon from its connexion with the back of the abdomen.—For the duodenum proceeds backwards from the pylorus, and passing down behind the peritoneum, enters a vacant space between the two lamina of the mesocolon; it proceeds for some distance in this space, and then emerges on the lower side of the mesocolon. Here the duodenum terminates, and the small intestine then is invested by the peritoneum in such a manner as to form the mesentery, which continues with it throughout its whole course to the great intestine. This portion of the intestine, although very uniform in its exterior appearance, as has been observed before, is divided into *Jejunum* and *Ileum:* the jejunum being the upper portion, which begins at the mesocolon; and the ileum the lower portion, which opens into the great intestine.

Of the Duodenum.

The length of this intestine is equal to the breadth of twelve fingers, and hence its name. It is very different from the rest of the small intestine, not only as respects its position and investment by the peritoneum, but on account of its connexion with the liver and pancreas, by means of their excretory ducts, which open into it. From this connexion with these glands, probably, all the peculiarities of its position are to be deduced.

When the stomach is in its natural situation, the pylorus is at some distance from the back of the abdomen. The duodenum proceeds backwards from this point, and passes near the neck of the gall-bladder, being here connected with the small omentum; it then curves downwards, and descends before the right kidney, sometimes as low as the lower part of it; then it curves again, and passes over to the left: after it has arrived at the left side of the spine, at the second or third lumbar vertebra, it projects forwards and downwards to form the jejunum. The only portion of this intestine which is moveable, is that which is in sight as it proceeds immediately from the pylorus, being about an inch and a half, or two inches in length. The remainder is connected to the back of the abdomen, and lies between the two lamina of the mesocolon. In its progress it passes before the aorta and the vena cava, but the principal branch of the vena portarum is before it.

The duodenum is larger in diameter than any other part of the small intestines, and has a stronger muscular coat. Its general situation admits of great dilatation, and it has been called a second stomach. Its internal coat is strictly villous in the anatomical sense of the word; and its folds, the valvulæ conniventes, begin at a small distance from the pylorus. The orifices of many mucous ducts are to be seen on its surface. It is supposed that some of these are the terminations of ducts from the glands of Brunner, which sometimes appear in the villous coat, or very close to it exteriorly; being small flat bodies, with a depression in the centre, and a foramen in the depression. They are sometimes very numerous at the upper extremity of this intestine, and diminish gradually towards the other extremity.

The biliary and pancreatic ducts open posteriorly

into the duodenum, rather above the middle of it. The orifice of these ducts is generally surrounded by a small tubercle, which is oblong, somewhat rounded at one extremity, and pointed at the other. Sometimes this orifice is in a plait, like one of the valvulæ conniventes. Most commonly the two ducts unite before they perforate the coat, so as to form but one orifice; and sometimes they open separately, but always very near to each other.

Absorbent vessels, which contain chyle, are found on the duodenum.

The Jejunum and Ileum

Are situated in the abdomen very differently from the duodenum. When the cavity is opened, and the omentum raised, they are in full view; and every portion of them except the two extremities and the parts near them, can readily be moved. This freedom of motion is owing to the manner in which they are invested by the peritoneum; or, in the technical language of anatomy, to the length of their mesentery. They agree in their structure with the general description of the small intestines, but their muscular coat is rather weaker than that of the duodenum. The valvulæ conniventes are very numerous and large in the upper part of the tube, or the jejunum; and gradually diminish in number, until they finally disappear in the lower part of the ileum. The villous coat is in perfection in the jejunum, the villi being more conspicuous there than in any other part of the intestinal tube. There are frequently found, exterior to this coat, but intimately connected with it, many small glandular bodies of a roundish form, which are often clustered together at that part of the intestine which corresponds with the interstice of the lamina of the mesentery. They are called Peyer's glands,

after the anatomist who first described them; and are supposed, like the glands of Brunner, to secrete mucus. If a portion of the jejunum be inverted, and moderately distended with air, these bodies appear very distinctly in it, dispersed at small distances from each other. In the ileum they appear in small clusters, which often have the appearance of disease.

No natural line of separation for distinguishing the jejunum and ilcum from each other, is to be found; but these names are still retained; and, therefore, a rule laid down by Winslow is generally adopted, viz. to name the first two-fifths of the tube jejunum, and the remainder ileum. There are, however, some important differences between these portions of the intestine.

In the jejunum, the valvulæ conniventes are so numerous, that they lie in contact with each other, as shingles on the roof of a house; in the ileum they gradually diminish in number, and finally disappear. In the jejunum, the villi are much stronger than they are in the ileum.

It is very difficult to acquire a precise idea of the arrangement of this part of the intestinal tube, while it is in the abdomen, especially if it be much distended; but if it be separated at each extremity from the intestine with which it is connected, and the mesentery cut off from the back of the abdomen, and the whole then spread out upon a flat surface, it will appear, as has been already said, that the intestine is arranged so as to form a semicircle, or large curve; the concavity of which is opposite to the back of the abdomen, while the convexity presents forward. It will also appear, when thus placed upon a table, that the intestine, while connected with the mesentery, is laid into many folds. It has been supposed, that the middle portion of the mesentery, and the intestine connected with it, is generally in the umbilical region;

and the two portions on the sides of it are in the iliac regions; but their situation in the abdomen varies considerably at different times. When the viscera of the pelvis are empty, a large portion of the small intestine is in the pelvis; but when those viscera are filled, the intestine is in the general cavity of the abdomen.

The Mesentery

Is a process of the peritoneum, which is formed in the manner of a plait or fold, and of course consists of two lamina. These lamina proceed from the back part of the abdomen, and are so near to each other, that they compose one substantial process; having cellular and adipose substance, blood vessels and nerves, with absorbent or lacteal vessels and their glands between them.

The form of this process, when it is separated from the back, and the intestines are detached from it, is somewhat semicircular: that portion of its margin or edge which corresponds to the diameter of the semicircle, is connected to the back of the abdomen, and called the root of the mesentery; the edge, which is the circumference of the semicircle, is connected with the intestine. The edge connected with the back of the abdomen is commonly about five or six inches in length: the semicircular edge, instead of extending fifteen or eighteen inches, the ordinary proportion, is attached to a portion of intestine sometimes twenty-four feet in length. The mesentery, on account of this great difference between its diameter and circumference, has been compared to the ruffle of a shirt sleeve; its roots being taken for the plaited edge of the ruffle, and the circumference for its loose edge. But the comparison is not precisely accurate; for the mesentery is not plaited at its root, but perfectly

smooth, and free from every kind of fold. It begins to enlarge towards its circumference, and enlarges to that degree, that it falls into plaits or folds: precisely such as would exist in a semicircular piece of membrane about six inches in diameter, if a number of simple incisions, of about an inch and a half in length, were made in a radiated direction from its circumference, and if portions like a sextant or quadrant were taken from a circular membrane three inches in diameter, and united by their edges to these incisions, so that their circumference might be continuous with the circumference of the large semicircular piece. In this case, the portions like quadrants or sextants would assume a folded position like the edge of the mesentery, while the middle of the semicircular piece would preserve its regular form without folds; as is the case with the mesentery at some distance within its circumference. By many additions of this kind, the circumference of a membrane, which was originally a semicircle of five or six inches, may be extended so as to exceed greatly that of the mesentery. It seems of course impossible to form an accurate model of the mesentery with a *single* piece of membrane or paper; but it may be easily made with clay, or any ductile substance. A model of this kind must necessarily be folded after the manner of the mesentery; and its circumference, like the mesentery, would appear as if formed of portions of the circumference of smaller circles united to each other.*

The root of the mesentery commences with the jejunum on the lower side of the mesocolon, at the left of the spine, and extends downwards near to the right iliac region, crossing the spine obliquely.

* A model, upon the plan first mentioned, was invented by Dr. J. G. Shippen. It has been proposed, I believe by M. Gavard, to make one with a single piece of buckskin, of a semicircular form, by stretching it at the circumference.

When it is examined in its natural situation, the peritoneum is found continued from the back of the abdomen to the intestine; it then surrounds the intestine, and continues from it to the back of the abdomen again. There must therefore be two lamina of peritoneum in the mesentery, and there must be a small portion of intestine answering to the interstice between these lamina which is not covered by the peritoneum. The blood vessels, and absorbents or lacteals pass most commodiously to the intestines between these lamina; for they are connected with large trunks that lie on or near the spine, and the root of the mesentery commences there.

The glands connected with the lacteals or absorbents are very conspicuous in the mesentery, and are commonly called mesenteric glands. They are of different sizes, from more than half an inch to one or two lines in diameter. They are very numerous, and scattered irregularly, but are seldom observed very near to the intestine. They are often enlarged in consequence of disease, especially in children.

The nerves of the small intestines which are derived principally from the superior mesenteric plexus, are also to be found here.

The adipose matter between the lamina of the mesentery is very often in large quantity, but varies, in proportion to the general quantity of adeps in the subject.

OF THE GREAT INTESTINES.

The Cæcum and Colon

Are very different from the small intestines in many respects. They are much larger in diameter; their external surface is marked by three longitudi-

nal bands of a light colour, which extend the greatest part of their length, and are placed nearly at equal distances from each other; the spaces between these bands are marked by transverse indentations, which pass from one hand to the other, at short but unequal distances. At these indentations the coats of the intestine are pressed inwards, as if a fine thread had been drawn round it externally, while the spaces between them are full and tumid, and on this account are called cells.

The great intestine, with these appearances, begins, as has been already observed, in the right iliac region, by a rounded end which rests on the fossa or concave surface formed by the costa of the ileum; from this it is continued upwards in the right lumbar region, anterior to the kidney, until it arrives near the liver, when it forms a curve, and passes directly across the abdomen to the left side. In this course it approaches so near to the under side of the liver, that it is often in contact with it, and with the gall bladder, which, after death, tinges it with a yellow colour. On the left side it passes down the lumbar region, before the kidney, to the left iliac region; here it is curved so as to resemble the Roman letter S, inverted: this curve generally carries it to the right side of the spine, and then brings it back to the centre of the sacrum. Here the intestine changes its course, and passing into the pelvis, continues downward, in contact with the sacrum and coccygis, and partaking of the curvature of those bones, until it terminates at the anus, where it is connected with the sphincter and levator ani muscles.

About two inches from the commencement of the great intestine, the ileum opens into it laterally; and all that portion which is between its commencement and the insertion of the ileum is termed *Cæcum*, or

the blind intestine: that part of the great tube, which is included in its course from the insertion of the ileum to the posterior part of the brim of the pelvis, is called *Colon;* and the remainder, or the part which is contained in the pelvis, is termed *Rectum.*

The *Cæcum* is nearly as wide as it is long; it is fixed in the right iliac fossa by the peritoneum, which invests it so that the great body of the intestine projects from the surface of the fossa covered by the peritoneum; but a portion is in close contact with the surface, and connected to it by cellular membrane. Its external surface, covered by the peritoneum, is marked by two of the bands or stripes before mentioned, which proceed on it lengthways. These bands are in full view, but the third band is generally on that part of the intestine which rests on the iliac fossa, and is therefore out of sight. At the rounded extremity of the cæcum, situated anteriorly and internally, is a small process resembling an earth-worm in form and size: this is therefore called *Appendicula Vermiformis.* It is hollow, and communicates with the cavity of the cæcum at the place of junction; and, like the cæcum, has its other extremity closed up. It is composed of the same number of coats and has the same structure as the great intestine: its length varies from two to four inches.

The longitudinal bands above mentioned commence at the junction of this appendix with the cæcum, and continue throughout the extent of the colon. They appear to be formed by some of the longitudinal fibres of the muscular coat, which are arranged close to each other. These fibres seem to be shorter than the coats of the intestine, and the interior coats adhere firmly to them. Thus are produced the indentations and cells; for if the bands are divided transversely, the indentations disappear, and the surface of the intes-

tine becomes uniform. One of these bands is covered by the mesocolon.

The circular or transverse fibres of the muscular coat of the *cæcum* and *colon* are very delicate, and not numerous.

The internal coat differs materially from that of the small intestines, although at first view they seem to resemble each other; for if a portion of the ileum and of the colon be inverted and suspended in water, no villi can be seen with the naked eye on the internal coat of the colon, while those of the ileum are very visible. The glands exterior to this coat are larger than those on the small intestines.

Instead of valvulæ conniventes, are the ridges made by the indentations or depressions above described, which separate the incomplete cells from each other. These ridges differ essentially from the valvulæ conniventes, because all the coats of the intestine are concerned in their formation, whereas the valvulæ conniventes are formed by the villous coat only; they also project into the cavity of the intestine, while the valvulæ are laid on its surface. They pass only from one longitudinal band to another, and, in consequence of this, the cells are small, and the position of each band is very evident when the intestine is laid open.

The communication of the ileum with the great intestine has been already stated to be on the left side of it, about two inches from its commencement. The aperture is so constructed, that it is considered as a valve, and is called the valve of Bauhin, or of Tulpius, after the anatomists who have described it.* The appearance of the aperture is as follows; If the cæcum, with a small portion of the ileum and

* Posthius in 1566; Vidus Vidius about 1569; Alberti in 1581: and Varolius, who died 1575, each lay claims to the discovery of it. Bauhin's claims are in 1579.—Ed.

of the colon may be separated from the other intestines, and kept in an inflated state until it be so dry as to preserve its form when opened, and then if the cæcum and colon be laid open opposite to the aperture of the ileum, a large transverse ridge, resembling some of the ridges or folds just described, will be seen projecting into the cavity of the intestine. In the internal edge of this fold is a long slit or opening, which forms the communication between the two intestines. It is obvious that the form of this fold must be that of a crescent; and that its two surfaces with the slit between them, must have the appearance of two lips, which would readily permit a fluid or substance of soft consistence to pass from the ileum into the great intestines, but must impede, if not prevent, its passage back; especially if the large intestines were distended, as then the lips would be pressed against each other.

When the peritoneal coat is dissected from each of the intestines at their place of junction, and this structure is then examined *from without*, it appears as if a transverse or half circular indentation had been formed by the villous coat of the great intestine, and that the internal coat of the extremity of the ileum was pressed into this indentation, and united to the internal coat of the great intestine which formed it; while there was a slit both in the indentation and in the end of the ileum, which formed a communication between the cavity of the great intestine and the ileum. The longitudinal fibres of both intestines, as well as their external coats, seemed to be united, so as to form a common cover for them; while the circular fibres were blended in the two portions of the indentation which form the lips of the orifice.

This orifice is, of course, transverse with respect to the intestine. It has been observed, that there was a difference in the thickness and strength of the

two lips or valves; that the lower valve was the strongest, and appeared to have the largest proportion of muscular fibres in its composition. At the extremities of the orifice, and near each end of the fold or ridge, are tendinous fibres, which give strength to the structure, they are called the Retinacula of Morgagni, as they were first described by that anatomist.

There is great reason for believing that this valve cannot prevent the retrograde motion of the contents of the intestines in all cases; for in some instances of hernia and of colic, matter perfectly stercoraceous has been vomited, and the probable inference from such a state of the ejected matter is, that this matter has been in the large intestines. It is also said, that suppositories and enemata have been discharged by vomiting.

On the right and left sides of the abdomen, the colon is in close contact with the posterior surface of the cavity. The peritoneum which covers this surface extends over the intestine also, and thus retains it in its position. The great arch of the colon, which is loose and moves far from the back of the abdomen, is invested by the two lamina of the omentum, which, after surrounding it, unite again and form the mesocolon. Connected with the exterior surface of the colon are many processes, composed of adipose membrane, varying in length from half an inch to an inch and a half: these appear to be of the nature of the omentum, and are therefore generally denominated *Appendices Epiploicæ.*

The Rectum.

After forming the sigmoid flexure, the colon terminates; and the rectum begins opposite to the lower surface of the last lumbar vertebra, and nearly in contact with it; from this it proceeds downwards, form-

ing a curve like the sacrum, until it terminates at the anus; where it is invested with the muscles called the sphincter, and levator ani. It is called rectum, because in this course it is supposed not to incline to either side; but it is often found on one side of the middle line.*

This intestine being in contact with the posterior surface of the pelvis, is covered, on its anterior surface only, by the peritoneum which lines the posterior surface of the pelvis; and it is fixed in this situation by the peritoneum, as the colon is on the right and left sides of the abdomen, but more loosely; and, therefore, the term *Mesorectum* has sometimes been applied to that portion of the peritoneum which is analogous to the mesentery and mesocolon. The peritoneum does not extend to the end of the rectum; for it is reflected at the lower part of the pelvis from the rectum to the bladder, or uterus, and does not line the bottom of the pelvis; so that the lower part of this intestine, as well as of the other viscera of the pelvis, is below the peritoneum, and not connected with it.

The muscular coat of the rectum is much thicker and stronger than that of any other intestine. The strata of longitudinal and circular fibres which compose it are very distinct from each other. The longitudinal fibres are most numerous, and terminate at the insertion of the fibres of the levator ani muscle.

The lower circular fibres are intimately connected with the sphincter ani.

The internal coat is very vascular, but the villous structure is not apparent. Mucous follicles are also very numerous; and there are likewise some distinct glandular bodies exterior to this coat, which vary in size in different subjects.

* Morgagni and Hallar supposed it to be commonly on the left of the middle line, and Sabatier on the right.

The quantity of mucus discharged from the rectum in certain cases of disease, is sometimes very great. The internal coat, in consequence of the contraction of the circular fibres exterior to it, sometimes forms longitudinal folds, which have been called its columns; these often disappear when the intestine is opened lengthways and spread out. By the contraction of the longitudinal fibres, the internal coat is often thrown into folds or doublings, that must assume a transverse or circular direction; they occasionally pass down through the sphincter, and form the prolapsus ani. The rectum is most plentifully supplied with blood vessels, to be described hereafter; and it may be observed, that, on the lower part of the internal coat, the veins are particularly numerous.

The internal coat of the rectum terminates abruptly just within the anus, and is united to a production of the skin, which, like the covering of the lips, is very delicate and vascular, and has an epithelium, or very thin cuticle, spread over it. The levator and sphincter ani muscles, with which the termination of the rectum is invested, are described in the first volume.

The *Absorbents of the Intestines* are commonly denominated *Lacteals.** They originate on the internal surfaces of these viscera, as has been already described. After passing through the lymphatic glands, which are so numerous on the mesentery, they generally unite and form one of the great trunks which compose the thoracic duct. It is asserted, that some of the absorbent vessels of the lower intestines unite to the lymphatics of the loins.

The *Nerves of the Intestines* are principally de-

* The Lacteals were first observed by Erasistratus and Herophilus, of the school of Alexandria, during the reign of the Ptolemies; and subsequently by Aselli, of Pavia, in 1622, the knowledge of them having been lost for 1900 years.—Ed.

rived from the intercostals, or great sympathetics. From each of these nerves, while they are in the thorax, an important branch, called the ramus splanchnicus, arises. These splanchnic branches pass through the diaphragm, and are the chief contributors to the ganglions and plexus formed in the abdomen. A plexus derived from this source surrounds the superior mesenteric artery, and another the inferior mesenteric; and from these proceed the nerves of the intestines.

The Omentum

Requires a separate description, although several circumstances connected with its structure have been already noticed. It often varies in its position; but when it is rendered firm by a quantity of adipose matter, it is spread over the intestines like an apron, extending from the lower edge, or great curvature of the stomach, towards the bottom of the abdomen.

As has been already said, it is an extension of the peritoneum, in two lamina, from the concave surface of the liver to the lesser curvature of the stomach; and these lamina, after surrounding the stomach, come in contact with each other near its great curvature. From this portion of the stomach, from the commencement of the duodenum, and also from the spleen, the *Omentum*, composed of two lamina, descends over the colon and the small intestines more or less low into the abdomen; it is then folded backwards and upwards, and is continued until it meets the great arch in the colon: here the lamina again separate and enclose that portion of the intestine, on the posterior side of which they again approach each other, and form a membrane like the mesentery, of two lamina, which passes from the concave or posterior surface of the colon to the back of the abdomen, where it is continued into the membrane which lines that surface.

This last portion is the *Mesocolon:* the portion between the liver and stomach is called the *Omentum of Winslow*, or the lesser omentum; and the great portion between the stomach and colon is called the *Great Omentum*, or the omentum gastro colicum. There is also a process of peritoneum continued from that portion of the colon which is on the right side of the abdomen, and from the cæcum, which extends to some distance; it is formed of two lamina, that compose a cavity of an angular form. This has been called the *Omentum Colicum.*

The great and small omentum, with a portion of the peritoneum on the back of the abdomen, form a sac, which encloses a distinct cavity in the abdomen. The anterior part of this sac is composed of two lamina, and between these lamina are the stomach and the great arch of the colon. This cavity, formed by the two omenta, communicates with the general cavity of the abdomen by a foramen of a semicircular form, called the Foramen of Winslow, which is behind the great cord of the vessels that go to the liver.

The omentum is so delicate in structure, that when free from fat, it is very liable to laceration, merely by adhering to the fingers, if they are dry. Winslow therefore advised that some unctuous substance should be rubbed on the hands, before they were applied to it.

The appearance of the great omentum is very different in different persons. In the emaciated, it appears like a delicate transparent membrane: in the corpulent, it is like a broad mass of adeps, which sometimes is very thick. When it is thus loaded with adeps, it is most commonly spread over the small intestines: when it is free from fat, it is often compressed together, so as to form a small mass near the arch of the colon, on the left side.

The principal blood vessels of the omentum are de-

rived from those of the stomach, and are called gastro epiploic arteries and veins.

The use of this membrane in the animal economy has not been ascertained with certainty. It seems probable that one of its principal objects is to protect the small intestines, and lessen the friction consequent upon their motion; but it has been supposed to answer several other important purposes.*

* See Halleri Elementa Physiologiæ, vol. vi. page 381.
Cavard. Traité de Splanchnologie, page 350.
Dr. James Rush's Inquiry into the use of the Omentum.

CHAPTER III.

OF THE LIVER, THE PANCREAS, AND THE SPLEEN.

SECTION I.

Of the Liver.

THIS largest viscus of the abdomen, when in a healthy condition, is of a reddish brown colour. If it is taken out of the subject, and laid on a flat surface, it is flat, but in the abdomen it is convex and concave.

It is situated in the right hypochondriac region, which it occupies entirely; and extends through the upper portion of the epigastric into the left hypochondriac region. Being placed immediately under the diaphragm, and in close contact with it, as well as with the inner surface of the right hypochondriac region, it partakes of their form, and is convex above and concave below. When thus situated, it is of an irregular figure, between the circular and the oval, but it is broader at the right extremity than at the left, and very irregular in thickness. The edge or margin which is in contact with the posterior part of the right hypochondriac region, is very thick. It gradually becomes thinner towards the left, and also towards the front; so that the right margin, and a large portion of the posterior margin, is very thick, while the left and anterior margin is thin.

The upper convex surface of the liver, when in its natural situation, is smooth: the lower concave surface is marked by several grooves or fissures and eminences. One of these, called the *Umbilical* or the great fissure, commences at a notch in the ante-

rior edge of the liver, to the left of the middle, and continues to the posterior edge. At the commencement of this fissure the umbilical ligament enters; and at the termination, or near it, the vena cava is situated. Opposite to this fissure, on the upper or convex surface, is a ligament passing from the diaphragm to the liver, which is called the falciform. The fissure and the ligament divide the liver into its two great lobes, the *Right* and *Left*.

Another great *fissure*, called the *transverse* or *principal*, commences in the right lobe and extends to the left, crossing the first mentioned fissure at right angles, and extending a very short distance beyond it. It is very deep, and rather nearer to the posterior than the anterior edge of the liver. In this fissure, near to its right extremity, the great vein, called vena portarum, and the hepatic artery enter, and the excretory duct of the liver, commonly called the hepatic duct, comes out. About the middle of the fissure are two prominences, one on each side; these were called the portæ, or gates of the liver, and hence the great vein was called vena portarum. This vein has two very large rectangular branches, which constitute what is called the sinus of the vena portarum; and they occupy the principal extent of the fissure.

The liver is in close contact with the vena cava behind; and there is either a groove in it for the passage of the vein, or this great vessel is completely enclosed by it. There is also an excavation on the lower surface of the liver, which is occupied by a portion of the gall bladder.

Besides the great lobes above mentioned, there are also two or three prominent parts on the concave surface, which are denominated lobes. One of these, called *Lobulus Spigelii*, is oblong, with two sides, and an angle continued along its whole length, which extends from the transverse fissure to the posterior

margin of the liver. It is situated between the posterior part of the transverse fissure, or ductus venosus, and the vena cava.

The anterior extremity of this lobe, which forms one of the margins of the transverse fissure, is somewhat bifurcated, and has been called lobulus caudatus. The largest portion of the bifurcated end forms a process like a papilla, and is one of the portæ.

Between the umbilical fissure and the depression for the gall bladder is a protuberant space, which varies from an inch and a quarter to two inches in breadth. This has also been called a lobe, *Lobulus Quartus* or *Anonymous;* its posterior point, opposite the papilla of the lobulus spigelii, forms the other porta of the liver.

The peritoneum is extended from the surface of the abdomen to the surface of the liver, in such manner as to cover it, and to form ligaments, which have a great effect in retaining it in its proper situation. The whole posterior edge of the liver is in contact with the back of the abdomen. The peritoneum above the liver is reflected to the upper surface of it, and the peritoneum below it to the lower surface; so that two lamina of the peritoneum pass from the lower part of the diaphragm at the back of the abdomen to the posterior edge of the liver. These processes of the peritoneum are considered as forming two ligaments, which are called the *right* and *left lateral ligaments.* A portion of the posterior surface of the liver, uncovered by the peritoneum, is often in contact with a portion of the tendon of the diaphragm, also uncovered by peritoneum: around this place of contact, the peritoneum is extended from the diaphragm to the liver, and thus forms what has been called the *coronary* ligament of the liver.

The peritoneum of the right side of the diaphragm, and of the abdominal muscles, as far down as the um-

bilicus, is extended to the liver, and joins it on the convex surface immediately opposite to the umbilical fissure. The peritoneum from the left side of these parts does the same; and as these reflections of the peritoneum are continued from so low a part as the umbilicus, they are extended not only to the convex surface of the liver, but also to the great notch, and along the umbilical fissure.

From the umbilicus proceeds a round cord-like ligament, which in the fœtal state was a vein, that passes to the great fissure of the liver, and along it. The process of the peritoneum above mentioned is so connected with this cord, that it encloses it in its lower edge, and the whole is called the *falciform* ligament of the liver. The cord, when named separately, is the *umbilical* or the *round* ligament; and the membrane or lamina of the peritoneum forms the *suspensory* ligament. Besides these, the peritoneum on the lower side of the liver is so arranged, that it not only extends to the stomach, but to the duodenum and the colon.

By these ligaments the position of the liver must be fixed to a great degree; and there is one additional connexion, which must have a great effect in retaining it in its proper situation. The vena cava receives two or three great veins from the liver, at the place where it is in contact with the posterior edge of that viscus: these veins of course pass directly from the substance of the liver into the cava, and connect it to that vessel. As the cava is supported by the heart, and also by the diaphragm, it must afford a considerable support to the liver.

When the stomach and intestines are distended, they must also contribute in a considerable degree to the support of the liver.

The liver has a strong tendency, when we are erect,

to change its situation; and some considerable support is necessary to counteract this tendency. It would move to the right, when we lie on the right side, if it were not in contact with the ribs; and it inclines to the left, for want of such support, when we lie on the left side.

It has been computed, that the liver descends about two inches, when the position of the subject is changed from the horizontal to the erect. As it is in contact with the diaphragm, it is obvious that it must be influenced by the motions of that muscle, and that it must descend when the diaphragm contracts.

The liver is composed of a substance which has some firmness of consistence, although it is yielding; and is also somewhat brittle or friable.* When cut into, the sections of many tubes, or vessels of different diameters, appear on the cut surface. When the texture of this substance is more closely examined, it appears somewhat granulated, or composed of very small bodies, which were called acini by the anatomist who first described them. The whole substance is enclosed by the peritoneum, which is extended to it from the surface of the abdomen in the manner that has been already described. It has also a proper coat or capsule; and on the posterior edge, where the lamina of the lateral ligaments pass from the diaphragm to the liver, at some distance from each other, a portion of the liver, covered by this coat and by cellular substance, is in contact with the diaphragm. The same thing occurs likewise at the coronary ligament.†

The liver holds the first place among the glands of

* It has been fractured in the living body by external violence.

† Many anatomists deny the existence of this coat; but if one of the lamina of the ligaments be carefully peeled off from the surface of the liver which is slightly affected by putrefaction, it will be apparent, although very thin. It was described by M. Laennec, in Le Journal de Medicine for 1803.

the body for size, but it is still more remarkable for some other circumstances in its economy. In addition to an artery, which passes to it as arteries do to other glands, there is a large vein which also enters it as an artery; and after ramifying throughout the liver, communicates, as does the artery, with other veins, which carry the blood from this gland into the vena cava and the general circulation. There are therefore three species of blood vessels in the liver; and with these are found the vessels which carry out of the gland the fluid secreted by it, or the bile.

The artery of the liver is denominated the *Hepatic Artery.* The vein which goes to the liver is called the *Vena Portarum,* from the place at which it enters. The veins which carry to the vena cava the blood brought to the liver by the hepatic artery and the vena portarum, are called the *Hepatic Veins;* and the duct through which the bile flows out of the liver, is called the *Hepatic Duct.* Three of these vessels, the *Hepatic Artery,* the *Vena Portarum,* and the *Hepatic Duct,* enter the liver at the great fissure, at the spot where the prominences exist called the portæ; hence the name vena portarum was applied to the vein.

These vessels ramify in the manner presently to be described; and it is ascertained by minute anatomical investigation, that the liver is entirely composed of the ramifications of these vessels and of the hepatic veins, with absorbent vessels and nerves, which are connected together by cellular membrane.

It has been already observed, that the first great branch sent off by the aorta in the abdomen, the *Cæliac,* divides into three branches, which go respectively to the stomach, the liver and the spleen.

The *Hepatic* is generally the largest of these branches. In its progress towards the liver it sends

off an artery to the stomach, called the gastrica dextra. At the great fissure it divides into two branches: the right branch, which supplies the right lobe of the liver, is of course the largest. This branch sends off one to the gall-bladder, which is called the cystic artery; and also some smaller branches: it passes under the hepatic duct, and ramifies through the great lobe of the liver. The left branch is distributed through the left lobe of the viscus. It can be proved by injection, that the hepatic artery communicates not only with the hepatic veins, but with the biliary duct, and the vena portarum also. It has been disputed whether the size of this artery is greater than would be requisite for the nourishment and animation of the liver.

The *Vena Portarum*, the great peculiarity of the liver, originates from all the chylopoetic viscera except the liver, and is of course formed by the union of the veins which correspond to all the branches of the cœliac and mesenteric arteries, as they are distributed to the stomach and intestines, the spleen, the pancreas, and the omentum. The veins from the intestines generally form two great trunks, which are denominated the greater and lesser mesenteric veins. The great mesenteric vein is situated to the right, and rather before the mesenteric artery.—After it has approached the origin of the artery, it separates from it, and passes behind the pancreas: at this place, nearly in front of the spine, it is joined by the great vein of the spleen, which forms almost a right angle with it, and these constitute the great trunk of the vena portarum. The lesser mesenteric vein, which corresponds to the inferior mesenteric artery, and brings blood from the pelvis and from the left part of the colon, becomes finally a large vessel, and commonly unites with the splenic about an inch and a half before its

junction with the superior mesenteric vein. The vena portarum, thus formed, proceeds towards the liver, inclining to the right, and is generally about three inches in length: in its course it sometimes receives small veins, which in other cases pass to its splenic and mesenteric branches. When it has arrived at the great transverse sinus of the liver, it divides into two large branches, each of which forms nearly a right angle with it. Their size is so great, that, when distended with injection, they appear like an independent vessel, into which the vena portarum enters; and on this account they are called the *Great Sinus* of the vena portarum. They do not adhere firmly to the glandular substance of the liver, but are united to it by cellular membrane. The right branch is the widest and shortest. It generally divides into three branches; an anterior, a posterior, and a lateral branch; which ramify minutely, and extend themselves in the right lobe. The left branch is much longer, and continues to the extent of the transverse fissure. Near its termination it is joined by the umbilical ligament, which has been already mentioned. This branch is generally in contact with a branch of the hepatic artery, and of the hepatic duct; and ramifies, like the right branch, into the contiguous parts of the liver.

The *Hepatic* or excretory duct originates, by very small vessels, from the acini or corpuscles of which the liver is composed, and into which the minute ramifications of the vena portarum and hepatic artery extend. They accompany these vessels, increasing as they increase, although the fluid they contain moves in an opposite direction; and two large branches which they ultimately form are situated at the portæ of the liver, in contact with the great branches of the vena portarum and the hepatic artery.

These three vessels are in contact with each other

before they enter the liver. The biliary duct is anterior, the vena portarum posterior, and the artery to the left of them. They are accompanied by nerves and lymphatic vessels, and are surrounded by a considerable quantity of cellular substance, and thus arranged are partially covered with peritoneum. The cellular substance which invests them continues with them into the liver, and is more particularly connected with the vena portarum. It is called *Glisson's Capsule*, and was supposed to have some contractile power, which assisted the circulation of the vena portarum; but that idea is now altogether abandoned. The hepatic veins, which receive the blood of the hepatic artery and the vena portarum, open into the anterior part of the vena cava, where it is in contact with the liver. Generally there are three of these veins, but sometimes there are only two; in which case one of them is formed by two others, which unite immediately before they open into the vena cava. It is to be observed, that the various branches of these veins do not accompany those branches of the vena portarum or hepatic artery to which they correspond, but form very large angles with them. This is probably owing merely to their termination in a part so distant from that in which the artery and the vena portarum originate; but it is very different from what occurs in other glands.

The *Nerves of the Liver* are derived from the semilunar ganglions of the splanchnic nerves. From these many nerves proceed, which form a net-work denominated the solar plexus. From this plexus many threads are sent off, which form a net-work that is divided into the right and left hepatic plexus. These plexuses surround the hepatic artery and the vena portarum, and accompany them in their ramications throughout the liver, being enclosed by Glis-

son's capsule. They receive some threads from the stomachic plexus, formed by the par vagum. Although the number of nervous fibres is very considerable, their bulk, compared with that of the liver, is very small.

The *Lymphatics of the Liver* are extremely numerous; and those in that portion of the peritoneum which invests the liver may easily be rendered conspicuous: for by pressure the injected fluid can be forced from the trunks and large branches into the small ramifications, in opposition to the valves. When all the surface is injected in this manner, it has the colour of the substance injected; as is the case with parts which are very vascular, when the blood vessels are injected.

The deep-seated lymphatics are also very numerous in the liver, and communicate freely with the superficial.

The superficial lymphatics, which are on the upper surface, proceed through the diaphragm into the thorax in their course to the thoracic duct. Those which are deep-seated emerge from the liver at the portæ, where the great vessels enter, and unite with the thoracic duct in the abdomen, after passing through several glands. The lymphatics of the lower surface unite with the deep-seated.

The glandular or parenchymatous substance of the liver is of a reddish-brown colour, and moderately firm consistence. When it is cut into, the cut surface exhibits the sections of the branches of the different blood vessels above mentioned, and of the excretory ducts. These vessels are often distinguishable from each other. The section of the biliary duct appears the thickest; that of the artery next; the vena portarum is next in order; and, last of all, the vena hepaticæ.

The branches of the vena portarum are surrounded by cellular substance, or Glisson's capsule; and, therefore, adhere less to the substance of the liver than the branches of the hepatic veins. The sections of the hepatic ducts have often bile in them, and are, therefore, termed pori biliarii. The branches of the artery are also very distinguishable.

When the internal substance of the liver is brought into view, and examined accurately, it appears to be formed of small bodies, or acini, which are distinguishable from each other. If the liver happens to be torn or lacerated, the lacerated surfaces are rough and irregular, owing to the separation of these acini from each other.

It is asserted by several microscopical observers, that a minute branch of each of the aforesaid vessels can be traced into each of the acini. It is also declared, that if each of these vessels be injected separately with mercury, oil of turpentine coloured, or a saturated aqueous solution of gutta gamba, there is no part of the glandular mass as large as a grain of mustard seed in which those vessels will not be found.

Several anatomists of the first character have likewise declared, that a fluid properly injected into one of these vessels, will occasionally pass into all of them. Thus an injection will not only pass from the vena portarum to the biliary duct, but to the hepatic artery and veins also. It will likewise pass, in a retrograde course, from the biliary ducts to the vena portarum; and to the hepatic artery and the hepatic veins; or from any one of the four orders of vessels into the three others.*

The great peculiarity of the liver is, that venous blood, instead of arterial, is brought to it for the purpose of secretion. Thus the great vein of the chy-

* I have tried the experiment, and find the assertion to be correct.—Ed.

lopoietic viscera, instead of passing to the cava, enters the liver by the transverse fissure, and takes on the office of an artery; its coats, on this account, being much thicker and stronger than those of the hepatic veins.*

The *Biliary* or *Hepatic Duct* is formed of very minute vessels, which originate in the acini above described: these unite together like veins until they form considerable branches, which finally compose the great ramifications of the biliary duct. This duct is very strong and firm, and on its internal surface are the orifices of many mucous follicles or ducts. It passes from the transverse fissure of the liver, with the hepatic artery, as before described, and at the distance of an inch and a half or two inches from the fissure, it unites with a duct from the gall bladder, which is called the *Cystic Duct.* This duct is nearly equal in length to the hepatic, and after running almost parallel to it, at length unites so as to form an acute angle with it. The cystic duct is smaller than the hepatic, and they unite much like two branches of an artery.

The *Gall Bladder,* from which the cystic duct arises, has the shape of a pear, with a very long neck, curved in a way to be hereafter described. It is situated in a superficial pit or cavity in the concave surface of the right lobe of the liver; and its fundus, or basis, often projects a small distance beyond the anterior edge of the viscus. Its position is such, that it extends from before backwards, and inclines rather to the left; of course, therefore, when the subject lies on his back, the bottom of the bladder is the upper-

* A case is related by Mr. Abernethy, in the London Philosophical Transactions, in which the vena portarum terminated in the vena cava below the liver, without communicating with it. The hepatic artery was the only vessel which carried blood to the organ, and was unusually large, the liver being nearly of the natural size. Some bile was in the gall bladder, but it was less acrid than usual.

most part of it: when he lies on the left side, it is also higher than the neck; and when he lies on the right side it is the lowermost.

The gall bladder consists of an internal coat, and one that is cellular or nervous, and has somewhat of a fibrous appearance. This coat connects the gall bladder to the surface of the pit or cavity in which it lies. The peritoneal coat of the liver is extended from the surface of the viscus over that part of the surface of the gall bladder which is not in contact with it.

The internal coat has a peculiar structure, with a faint resemblance to that of the villous membrane. It is so arranged as to form very fine folds, which have various directions: in some places they make a net-work; in others, as the neck of the bladder, they are longitudinal. Many mucous follicles exist on its internal surface.

The neck of the gall-bladder is suddenly bent down or curved upon itself, and twisted, so that it resembles the neck of the swan, when the head of that bird is applied to one side of its breast.

A branch of the hepatic artery, which leaves it before it enters the liver, is appropriated to the gall bladder, and is, therefore, denominated the cystic artery. *The veins corresponding to this artery empty themselves into the vena portarum.** The lymphatic vessels are united to those which are found on the lower surface of the liver, and the nerves are derived from the hepatic plexus.

The gall bladder appears to be merely a reservoir, into which bile passes through its duct in a retrograde direction. If air be blown through the hepatic duct from the liver, it will pass to the gall bladder almost as freely as it passes to the duodenum.

* It has been justly observed by John Bell, that the veins would not terminate thus, if bile were secreted by the gall bladder.

The biliary duct from the liver, after receiving the duct from the gall bladder, takes the name of *Ductus Communis Choledochus.* It is wider than either of the other ducts, and near three inches in length. It passes down before the vena portarum, and on the right of the hepatic artery, to the posterior surface of the right extremity of the pancreas. It passes through a small portion of that gland, and then perforates the muscular coat of the duodenum; after which it proceeds from half an inch to an inch between this coat and the villous, and opens into the cavity of the intestine. The orifice forms a tubercle which extends lengthwise of the intestine, and is rounded above and pointed below, with a slit in it. While this duct is in contact with the pancreas, a duct from that gland generally opens into it, so that the biliary and pancreatic fluids enter the duodenum by the same orifice; but sometimes the pancreatic duct opens into the duodenum, by a distinct orifice, very near to that of the biliary duct.

The *Bile*, or fluid secreted by the liver, appears to answer a two-fold purpose in the animal economy. It produces a chemical effect upon the alimentary mixture which passes from the stomach through the intestines; and it increases the peristaltic motion of those important organs.

By an inverted action of the duodenum, some of this fluid is frequently carried upwards into the stomach : it then often produces only slight derangement of the functions and sensations connected with that viscus; but sometimes *violent vertigo, and even convulsions*, seem to have arisen merely from the presence of a large quantity of bile in the stomach : for they have gone off completely upon the discharge of bile by vomiting.

Notwithstanding these effects of bile in certain cases, in which a great deal of it exists in the stomach, it is often carried into the mass of blood in

large quantities, and appears to be mixed with the serum, and to circulate through the body, without producing any very sensible effect: thus many persons who are deeply tinged by bile in their blood, experience but few effects that can be imputed to the mixture of it with the circulating fluids: and neither the brain nor the heart appears to be much influenced by the circumstance.

Bile is miscible with water and with alcohol, and also with oily substances; and it often assumes a green colour, when mixed with acids. The colour of the alvine discharges is derived from the bile, and they are therefore sometimes very green, when the acetous fermentation takes place in the contents of the stomach and bowels.

It is asserted by some chemists, that ten parts in eleven of the human bile consists of water; that albuminous matter composes about one forty-sixth part of it; and that there is nearly an equal quantity of resinous matter in it. There is also a small quantity, (one part in 244,) of uncombined soda dissolved in it, and a smaller quantity of neutral salts, consisting of soda combined with the phosphoric, sulphuric and muriatic acids. In addition to these is a very small quantity of phosphate of lime and of oxide of iron, and some yellow insoluble matter.

The bile in the *Gall Bladder* is generally more viscid than that which is found in the *Hepatic Duct.*

SECTION II.

Of the Pancreas.

The pancreas is a glandular body, which has a strong resemblance to the salivary glands in several particulars. It is seven inches in length, and is irregularly oblong in its form, one extremity being much larger than the other. Its large extremity is in contact with the duodenum, and it extends from this intestine in a transverse direction to the spleen, to which it is connected by the omentum and by blood vessels.

It is not invested by the peritoneum, but is situated in the space which exists between the two lamina of the mesocolon, as they proceed from the back of the abdomen, before they come in contact with each other. It is anterior to the aorta and vena cava, and to the mesenteric vein, or main branch of the vena portarum; being connected to these parts by cellular membrane. At the right extremity, which is connected with the duodenum, is a process of the gland that extends downwards in close contact with the intestine. This is called the head of the pancreas, or the lesser pancreas.

The position of the pancreas is such, that one of its surfaces looks forwards and rather upwards, and the other backwards and downwards; one edge is of course posterior and superior, and the other anterior and inferior. The posterior of these edges is much thicker than the other, and has a groove or excavation which is occupied by the splenic blood vessels.

This gland differs from the other large glands of the abdomen, inasmuch as it has not a large artery particularly appropriated to it; but instead of this, it receives branches from the contiguous arteries.

The arterial blood of this gland is partly supplied by the splenic artery, which, in its course from the main trunk of the cœliac to the spleen, while it is in the groove at the edge of the pancreas, sends off into the gland one considerable branch called the great pancreatic, and a number of small branches, which go off in succession. In addition to these, the pancreas receives vessels from one of the branches of the hepatic artery, before it sends off its great ramifications, as well as small twigs from several other contiguous arteries. The veins correspond with the arteries, but ultimately are discharged into the vena portarum.

The pancreas resembles the salivary glands in colour, and also in texture; for it is of a dull white colour with a tinge of red, and it appears to consist of small bodies of a granulated form, which are so arranged as to compose small masses or lobes that are united to each other by cellular membrane. Each of these granulated bodies receives one or more small arterial twigs, and from it proceeds not only a vein but a small excretory duct, which, uniting with similar ducts from the adjoining granulated portions or acini, forms a larger duct in each lobe or mass; these open into the great duct of the gland, which proceeds through it lengthwise from the left extremity, in which it commences, to the right.

This duct is situated in the body of the gland, which must be dissected to bring it into view. It is thin and transparent, like the ducts of the salivary glands, and is rather larger in diameter than a crow's quill. In its progress towards the right extremity of the gland, it gradually enlarges, and commonly receives a branch from the part called the lesser pancreas. It most commonly unites with the biliary duct before it opens into the duodenum: sometimes these ducts open separately, but very near to each other. They penetrate the coats of the intestine, rather obliquely, and between four and five inches from the pylorus. This canal is sometimes called *Ductus Virsungii*, after an anatomist who published a plate of it.

The pancreas has an irregular surface, and no coat which covers it uniformly. It is invested by cellular membrane, which also connects its different lobes to each other. Absorbent vessels and nerves are traced into it.

The portion called the lesser pancreas adheres to the duodenum, and when it is enlarged by disease,

the passage of aliment through that intestine is much impeded, and sometimes completely obstructed.*

It is now generally believed that the fluid secreted by the pancreas is similar to that which is produced by the salivary glands.

SECTION III.

Of the Spleen.

THE Spleen is a flat body of a bluish colour, and an irregular oblong form, with thick edges, which are indented in some places.

It is various in different subjects, both in size and form. Its most common size is between four and five inches in length, and about three or four inches in breadth; but it has often been found of more than four times this size; and it has also been seen not much longer than an inch. Its ordinary weight is between six and nine ounces; but it has varied in different subjects from eleven pounds to one ounce. It is supposed, by many physiologists, that it frequently varies in size in the same individual.

It is situated in the left hypochondriac region, in contact with the diaphragm, below the eighth rib. The position of the spleen is somewhat oblique,—one extremity being directed downwards and rather forwards, and the other upwards and backwards; but when the stomach is distended, the lower end of it is pushed forward by the great extremity of that viscus.

In general it is so deeply seated in the left hypo-

* In several cases where examination after death evinced that the pancreas had become enlarged and indurated, particularly at the right extremity, the principal symptoms were *jaundice; great uneasiness after taking food; vomiting some time after eating, but not immediately; extreme acidity of the matter rejected.*

chondriac region, that it is out of view when the subject is opened in the ordinary way: but in some cases of enlargement, after the intermitting fever, it has extended downwards, nearly as low as the pelvis; and towards the right side beyond the umbilicus.

The external surface of the spleen is convex, in conformity to the surface of the diaphragm, with which it is in contact. The internal surface of the spleen is irregularly concave, having a longitudinal fissure which divides it into two portions.

The spleen is invested by the peritoneum, one process of which is often extended from the diaphragm, above and behind it, in the form of ligament. Another process of the same membrane is extended to it from the great extremity of the stomach. The peritoneum is also continued from the spleen in the form of omentum.

Within this peritoneal covering is the proper coat of the spleen, which is so closely connected to it, that many anatomists have considered them as one membrane: they are, however, very distinct at the great fissure, but the external coat is extremely thin.

The proper coat of the spleen is not very thick; it is dense and firm, and somewhat elastic, *but not much so*. It is partly transparent.

The spleen has a large artery, which is one of the three great branches of the cœliac. This vessel runs in an undulating manner in a groove in the upper edge of the pancreas, and in this course sends off many small branches to supply that gland. The splenic artery, before it arrives at the spleen, divides into five or six branches, which are also undulating in their progress, and penetrate into the body of the viscus at the above mentioned fissure. These branches are distributed to every part of the viscus, and ramify minutely.

From these branches, or from the main trunk before it ramifies, three or four smaller branches proceed to the left extremity of the stomach. They are called vasa brevia or arteriæ breves.

The arteries which enter the spleen are accompanied by veins that emerge from it, and unite to form a great trunk. This trunk observes a course corresponding to that of the splenic artery, and receives veins from the stomach and pancreas, which correspond with the arterial branches sent to those organs. The splenic vein is one of the principal branches of the vena portarum.

The splenic artery is very large in proportion to the viscus to which it is sent, and the vein is unusually large in proportion to the artery. The vein is also very tender and delicate in its structure.

The absorbent vessels of the spleen are very numerous. It has been asserted, that when those of the *external* coat of the spleen are injected, they are sufficient to form a fine net-work on it. The absorbents of the deep-seated parts unite to the superficial at the fissure where the blood vessels enter. They terminate in the thoracic duct, after passing through several lymphatic glands.

The nerves of the spleen are derived from the solar plexus: they form a plexus round the vessels, and accompany them through the viscus.

The spleen consists of a substance which is much softer than that of any other viscus of the abdomen. This substance is made up either wholly or in great part of the ramifications of the splenic artery and vein, which are demonstrated by injections to be very minute and numerous in this body. There are also many fine white cords, like threads, which pass from the internal surface of the inner coat of the spleen into its soft substance, in which some of them ramify. These

cords connect the substance of the spleen pretty firmly to its coat, and they seem to have the effect of rendering the exterior part of the substance more firm and dense than the internal. They are particularly conspicuous if the spleen be immersed in water, and the coat pulled off while it is in that situation.

The spleen has a strong resemblance to the glandular organs, but has no excretory duct, and its particular function is not very obvious: for these reasons the structure of this organ is a subject of very interesting inquiry.

Malpighi, who took the lead in researches of this nature, before injections of the blood vessels with wax were in use, after investigating the structure of the spleen by long maceration, by boiling, by inflation, by the injection of ink or coloured fluids, and by examination with microscopes, declared that its structure was cellular; that the cells communicated more freely with the veins than the arteries; and that they might be considered as appendices of the veins. He also asserted, that a large number of white bodies or vesicles were to be found in those cells and throughout the whole substance of the spleen, which were in bunches like grapes, and preserved their whitish colour although the vessels around them were injected with a coloured fluid. This description of Malpighi appears to have been admitted by some of the very respectable anatomists who were contemporary with him; but it was zealously opposed by Ruysch, who exhibited the spleen so completely injected with wax, that it appeared to be composed entirely of vessels.*

* Two plates, taken from drawings of these preparations, are published in Ruysch's Works. One is attached to Epistola Problematica Quarta, in the second volume; and the other to Thesaurus Septimus, in the third volume.

Ruysch appears to have paid great attention to this subject, and to have made many preparations of the spleen. From these he derived the opinion, that the substance of this organ was entirely composed of arteries, veins, absorbent vessels, and nerves; and that if it were properly injected before it was dissected, no other structure would be found. He stated, that the minute ramifications of the blood vessels appeared to have acquired a peculiar quality, and were so soft and delicate that their texture was destroyed by the least friction; and that by the slightest degree of putrefaction they appeared to be reduced to a fluid state. He also denied the existence of cells, or of the whitish bodies described by Malpighi.

The question thus at issue between these great masters of their art was very carefully examined by M. De La Sone, a French physician, whose observations are published in the Memoirs of the Academy of Sciences for 1754. After repeating the processes of each of these anatomists, and instituting some others in addition, he adopted the opinion that there was in the texture of the spleen a pulpy substance which was not a mere coagulum, but which, however, could not be injected.

He derived his opinion from this fact among others. After macerating the spleen a considerable time, and injecting water into the vessels until it returned colourless, he injected ink, and confined it some time in the vessels by tying them: he then allowed the ink to flow out of the vessels, and made various sections of the spleen; but no ink appeared in the pulpy substance, although it was visible in many small vessels which ramified in that substance. He observes that this could not have been the case, if the pulpy substance had been composed entirely of vessels, as was supposed by Ruysch.

He also examined the spleen after it had been injected with wax, according to the manner of Ruysch, and believed not only that the pulpy matter remained uninjected, but that Ruysch himself, in his own preparations, removed this substance, supposing it to exist for the mere purpose of connecting the vessels to each other.

To see the blood vessels in the same state of distention in which they were during life, he tied the splenic vessels in a living animal, and removed the spleen with the ligatures on the vessels. In this situation he boiled it, and then examined the appearance of the vessels and the pulpy substance.—From these, as well as his other observations, he decided, that the pulpy substance did not consist entirely of vessels, but was an additional and different structure.

He also suggested, that as the brain and the muscular fibres were so covered by blood vessels in the injected preparations of Ruysch, that they appeared to be composed entirely of vessels, when in fact they consisted of a different substance, so the pulpy substance of the spleen was covered or obscured by the blood vessels which passed through it, without constituting its whole substance.

He confirms the account of Malpighi respecting the *Whitish Vesicles or Follicles;* and states, that in a majority of cases they are not to be discovered without a particular preparation; but that they are generally made obvious by long maceration of the spleen in water. In his opinion they are the most essential part of the organ.

Notwithstanding these investigations of M. De La Sone, the question respecting the structure of the spleen remains not completely decided even to this day.

Haller, who was perfectly well acquainted with the

subject, inclined to the opinion of Ruysch; while Sabatier adopted completely the opinion of De La Sone.

It appears from the statement of Gavard, that Desault did not admit the existence of the transparent bodies; although he believed that the pulpy substance of the spleen consisted of cells which resembled those of the cavernous bodies of the penis.

Boyer, whose descriptions of the animal structure appear to have been formed with scrupulous exactitude, admits the existence of transparent bodies; sometimes so small as to be scarcely visible, and sometimes as large as the head of a pin. He observes, that the best method of examining them is to place a very thin slice of the spleen between the eye and a strong light, when the transparency of these bodies occasions the slice of the spleen to appear as if perforated.

As to the general structure of the pulpy substance, he avows himself unable to decide respecting it; but observes, that upon examining the cut surface of the spleen, you perceive black liquid blood flow from the vessels; if you then scrape this surface, you may express easily a species of sanies different from that which flows from the vessels, which, after exposure, becomes red, and resembles coagulated blood; whether this is contained in the capillary vessels, or in the cavities of this organ, he acknowledges himself unable to determine.

Notwithstanding the sentiments of these French gentlemen, many of the British anatomists, who are entitled to great attention on account of their skill in minute injections, have adopted the ideas of Ruysch. Among these are to be mentioned the late Dr. F. Nicholls, and many of the anatomists of London, as well as the second Professor Monro, of Edinburgh. There are, however, two remarkable exceptions to this account of the British anatomists. The late Mr. Falco-

ner, who wrote a dissertation on the situation and structure of the spleen, which contains the sentiments of the late truly respectable Mr. Hewson,* after stating that the organ was extremely vascular, so that when injected; it appeared like a mere congeries of vessels, makes this unequivocal assertion—that there are innumerable cells dispersed throughout the whole substance of it, which are so small that *they are only to be discovered by the aid of a microscope;* and are to be seen after steeping a thin piece of spleen, the blood vessels of which have been minutely injected in clear water during a day, and changing the water frequently. He also adds, that the ultimate branches of the arteries and veins form a beautiful net-work on each cell; and that these cells are sufficiently distinguished from the irregular interstices of the cellular substance, by their round figure and their great regularity.

Mr. Everard Home, in his papers on the structure and uses of the spleen, confirms the account of the vesicles in this organ; and adds that these vesicles are occasionally seen in a distended and in a contracted state. That when distended they are twice as large as when contracted, and are distinguishable by the naked eye; whereas, when contracted, they require a magnifying glass to be distinctly seen. These observations appear to have been made upon quadrupeds.†

Professor Soemmering appears to unite in the *general* sentiment of the British anatomists, that the spleen is *simply vascular.* He says, that the tuberculi which sometimes appear in it, when examined with a magnifying glass, appear to be composed entirely of vessels.

* See Experimental Inquiries, vol. iii.

† See the London Philosophical Transactions for 1808.

There are, therefore, two questions not perfectly decided respecting the spleen.

First. Whether its general structure is simply vascular; or whether there is any other structure either cellular or more substantial, which composes its general bulk.

Second. Whether the small transparent vesicles, originally described by Malpighi, are to be regarded as essential parts of the structure of the spleen.

With respect to the first question, the injections of Ruysch, and of the British anatomists in general, and even of Mr. Hewson, as well as of Haller and Soemmering, seem to afford *positive* facts in opposition to those of a *negative* kind adduced by M. De La Sone, and render it highly probable that the *general* structure is simply vascular.

But the second question stands on different grounds. The existence of small transparent vesicles, although denied by Ruysch, and neglected by the British anatomists in general, was asserted as a *positive* fact by Malpighi and De La Sone; and their assertions have been confirmed, not only by most of the French anatomists, but also by Hewson and Home among the British.

The sentiments of physiologists respecting the functions of the spleen, are more discordant than those of anatomists respecting its structure; although the subject has been considered by many authors of great ingenuity.*

* See M. Lieutaud, Elementa Physiologiæ.
Hewson's Experimental Inquiries, vol. iii.
Dr. Rush, Medical Museum, vol. iii.
Haller, Elementa Physiologiæ, tom. vi. page 414.

CHAPTER IV.

OF THE URINARY ORGANS AND THE GLANDULÆ RENALES.

THE urinary organs consist of the *Kidneys*, which are situated in the lumbar regions; of the *Bladder*, which is in the pelvis; of the *Ureters*, which are flexible tubes or canals that pass from the kidneys to the bladder; and of the *Urethra*, or tube through which the urine is discharged from the bladder.

These organs have but little connexion with the peritoneum. The kidneys are behind it, and a considerable quantity of cellular membrane is placed between them and it. The ureters are also behind it; and but a part of the bladder is invested with it.

The *Glandulæ Renales* are described with the urinary organs, on account of their contiguity to the kidneys; and, to avoid a derangement of the natural order of description, they are considered first.

The urethra pertains to the organs of generation as well as to the urinary organs, and can be described most advantageously with them.

SECTION I.

Of the Glandulæ Renales.

THESE are two small bodies, situated on the psoas muscles, one on each side of the spine, behind the peritoneum and above the kidney, being in contact with its upper and anterior edge. They have an irregular semilunar figure with three sides, one of which is ac-

commodated to the convexity of the kidney. Their colour is commonly a dull yellow.

The appearance and texture of these bodies have some resemblance to those of glands, and hence their name, but they have no excretory duct.

When they are laid open by an incision, a cavity often appears, which is somewhat triangular, and from the lower part of it a small thin ridge arises.*

A small quantity of fluid is generally found in it, which has a very dark colour in adults, is yellowish in young subjects, and red in infants.

These bodies have not a single artery appropriated to them, as the spleen has, but receive small branches from several contiguous sources; namely, from the arteries of the diaphragm, from the cœliac artery or the aorta, and from the arteries of the kidneys. There is generally one principal vein, as well as some that are smaller, belonging to each of these bodies: the large vein, on the right side, generally opens into the vena cava; and, on the left, into the left emulgent vein.

These bodies were first described by Eustachius, and have been regarded with attention by many anatomists since that period. They exist in a great number of animals; but their nature and functions are altogether unknown.

SECTION II.

Of the Kidneys and Ureters.

The kidneys are two glandular bodies which secrete the urine. They are of a dull red colour, and their form has a strong resemblance to that of the bean which bears their name. They have a peculiar tex-

* The cavity in these bodies has sometimes been sought for in vain. Haller found it in sixteen cases out of nineteen.

ture, which is uniform, and not granulated or composed of acini; and they are covered by a thin delicate tunic, which has no connexion with the peritoneum.

They are situated in the lumbar regions of the abdomen, one on each side of the spine. They are opposite to the two last dorsal and the two first lumbar vertebræ. They rest principally upon the psoas and quadratus lumborum muscles, and their position is oblique; the concave edge presenting inwards and forwards, the convex edge backwards, and the upper extremity approaching nearer to the spine than the lower.

The *Right Kidney* is situated rather lower than the left: it is below the posterior part of the right lobe of the liver, and behind the duodenum and the colon. The *Left Kidney* is below the spleen, and behind the descending portion of the colon. Each of the kidneys is below and very near to one of the glandulæ renales.

They are surrounded with a large quantity of lax adipose membrane, which in corpulent persons forms a very large mass of adeps around them; while in the emaciated they are surrounded with a membrane almost free from fat. Each kidney has two broad sides, two extremities, and two edges. The side or surface which is posterior, when the kidney is in its natural situation, is rather broader than the other. The upper extremity, or portion, is also broader and larger than the lower. The edge which is posterior and external is regularly convex; the anterior edge is concave; but the concave edge or margin is not very regular. In the middle it is largely indented; in this indentation is a deep fissure, which separates the two broad surfaces or sides of the gland from each other; and here the breadth of the posterior surface is evidently greater than the anterior.

Each of the kidneys receives a large artery, which proceeds immediately from the aorta, nearly in a rectangular direction. A vein, which opens into the vena cava, accompanies the artery. It is obvious, from the situation of the kidneys with respect to the great vessels, that the artery on the right side must be longer than that on the left, and that the reverse of this must be the case with the veins; the veins are also anterior to the arteries. At the great fissure these vessels divide into several branches, which enter the kidney at that place. The branches of the vein are before and above; those of the artery are below, and in the middle. Surrounded more or less by the branches of those vessels, is a membranous sac; the breadth of which extends from above downwards. This sac terminates in a tube that proceeds from the lower part of the fissure down to the bladder. The sack is denominated the pelvis of the kidney, and the tube a ureter: each of these parts will soon be more particularly described.

The substance of the kidney, as has been already said, is uniform in its texture, and of a reddish brown colour. When it is divided by an incision made lengthways, and from its convex to its concave edge, there appears to be a small difference in the different parts of it. The exterior part, which is called cortical, is rather more pale in colour and softer in consistence than the internal part. It varies in thickness, so that some writers have described it as equal to two lines, and others to one-third of the kidney. In a majority of subjects it will be found between the two statements.

The interior part is called medullary, or tubular, and appears to be composed of very fine tubes. These tubes are so arranged, that a number of papillæ or cones are formed by their convergence, and project

into the fissure of the kidney. These papillæ have been supposed to consist of a substance different from either of the two above mentioned, but they appear to be formed merely by the tubular part.

The arteries, accompanied by corresponding veins, and by nerves and absorbent vessels, after ramifying in the fissure of the kidney, proceed into its substance, and continue their aborescent ramifications until they have arrived very near the exterior surface. They are so uniformly distributed to the different parts of the organ, that when the blood vessels are injected with wax, and the substance of the kidney is removed from the injected matter, as is the case in corroded preparations, the injection exhibits accurately the form of the kidney.

The *large branches* of the blood vessels occupy the vacuities between the papillæ in the fissure of the kidney. When they penetrate the substance of the kidney, they are enclosed by sheaths which are derived from the coat of the gland, and are surrounded by membrane which frequently contains adeps.

There are commonly ten or twelve papillæ in the fissure of each kidney, but there are sometimes more and sometimes less than this number. These papillæ are surrounded by a membranous sac of a corresponding form; the papillæ being a cone, and the sac resembling the upper part of a funnel. The sac is therefore called an infundibulum, or calyx. Sometimes there are two papillæ in each infundibulum, and then the form of the sac is not so regular. The infundibulum adheres to the base of the papillæ, but lies loose about the other parts of it. Each infundibulum communicates at its apex with the pelvis of the kidney.

The *Pelvis*, as has been already mentioned, is a membranous sac which terminates in the ureter, exterior to the kidney. This sac generally divides itself,

in the fissure of the kidney, into three large irregular branches, each of which very soon terminates in three or four of the infundibula above described. That portion of the sac which terminates in the ureter is exterior to the kidney.

When the interior parts of the kidney are exposed to view, by the section above mentioned, after the arteries and veins have been minutely injected, the cortical part will be found to consist almost entirely of the minute ramifications of these vessels. Among them are some small bodies, which are dispersed through the substance, like berries on a bush: these are asserted also to be composed of vessels.

The tubular part certainly proceeds from this vascular cortical substance: for Ruysch, and after him several other injectors, have filled these tubes with injections thrown into the arteries.

The tubuli, of which this part is composed, seem to arise obscurely from the cortical part. They soon assume somewhat of a radiated direction, and are finally arranged so as to form the papillæ or cones above described.

On these papillæ or cones some of them can be traced, uniting with each other, to form larger tubes, which terminate on the surfaces of the papillæ, in orifices large enough to be seen distinctly. From these orifices urine may be forced out by compressing the papillæ. On this account the tubes have been called tubuli uriniferi.

In the fœtal state the kidney is formed of a number of distinct lobuli, each of which consists of a papilla with the cortical matter connected to its base. Soon after birth these lobuli coalesce; and in two or three years the substance of the kidney appears uniform, as above described. In some animals this lobulated structure continues during life: in them, and also in the

fœtus, each lobe appears like a distinct organ. Although in the adult kidney this structure has disappeared, the papillæ and the tubular part connected with them are somewhat detached from each other, in a manner corresponding to their original arrangement.

The *Nerves of the Kidneys* originate from the semilunar ganglion, formerly mentioned. They form a plexus round the blood vessels, and go with them into the gland.

The kidneys have internal and external absorbent vessels, although the external vessels are very small. These absorbents pass through glands in the lumbar region to the thoracic duct.

The *proper* coat of the kidney is said, by some anatomists, to consist of two lamina; but this cannot be shown in common cases. It appears simple in its structure, and very flexible. It is but slightly connected to the glandular substance which it encloses, and may be easily pealed off. It is reflected inwards at the fissure of the kidney, and can be traced inwardly to some distance, forming sheaths for the vessels. In this internal situation it is very thin.

The Ureters.

The pelvis of the kidney terminates exteriorly in the *Ureter*, which is a membranous cylindrical tube, rather flattened, and between three and five lines in diameter, with some variations in this respect.

The *Ureters* descend from the pelvis of the kidney so as to pass obliquely across the psoas muscle and the great iliac vessels. They are behind the peritoneum, but in contact with it. They approach the pelvis near the junction of the os ilium with the sacrum, and thence descend forwards and inwards, surrounded with loose cellular membrane, to the

lower part of the bladder, into which they are inserted at its external and posterior part. They first penetrate obliquely the muscular coat, and then proceed between the muscular and internal coats from half an inch to an inch, in an oblique direction, from without inwards and forwards, when they terminate by small orifices in the internal coat, each of which is at an equal distance, (rather more than an inch,) from the orifice of the urethra, thus forming a triangle with it.

The ureters are said to have three coats. The exterior appear to be derived from the cellular substance: within it is another, which has been regarded very differently by different anatomists; some considering it as merely membranous, and others as muscular. If the ureter be laid open and the internal coat peeled off, the muscular structure of this coat is often very perceptible.

The internal coat is called villous, or mucus, and is continued from the internal coat of the bladder. Over this coat mucus is constantly spread, which defends it from the acrimony of the urine. It is very difficult to separate the two last mentioned coats from each other.

The ureters receive blood vessels and nerves from those of the neighbouring parts. Their internal coat is very vascular, and is also very sensible of irritation. The passage of a small urinary calculus can be traced from the pelvis of the kidney to the bladder, by the exquisite pain and the spasmodic affections which it often excites.

SECTION III.

Of the Urinary Bladder.

THE urinary bladder is a large sac, of a muscular and membranous structure, which occupies the anterior part of the cavity of the pelvis, immediately within the ossa pubis.

The size of the bladder is in a continued state of variation, according to the quantity of urine secreted. When moderately distended, it is of an irregular oval form, but rather more flat at its lower extremity than above. It varies in form according to the different circumstances of the pelvis to which it has been subjected.

It is fixed firmly and immoveably to the pelvis immediately within the symphysis pubis; so that it is always to be found there of a larger or smaller size. This fixture is produced by the attachment of the lower portion of fundus of the bladder to the parts beneath it, but principally by the anterior ligaments of the bladder which proceed one on each side from the lateral surfaces of the prostate gland, and are inserted into the pubis of the corresponding side at the lower part of the symphysis. These ligaments are in fact the extension of a membrane, (called by the French anatomists, the pelvic aponeurosis,) which proceeds from the upper part of the pelvis to the side of the prostate gland and bladder, and which may be seen by turning off the peritoneum from the levator ani muscle.* It is sometimes completely empty, and occupies no more space than the thickness of its

* See Thesis on Femoral Hernia, &c., by Gilbert Breschet. Paris, April, 1819. Colles' Surgical Anatomy, Dublin, 1811, for a more minute account of this membrane.—ED.

coats requires. When moderately distended, it occupies a considerable portion of the pelvis: when distention increases, it presses the parts posterior to it against the sacrum, and extends itself above the brim of the pelvis into the general cavity, rising not only to the umbilicus, but in some cases to the epigastric region.

In males the relative situation of the bladder and rectum is such, that the upper and middle part of the rectum is behind the bladder; but the lower part of the rectum, following the curve of the os sacrum and coccygis, is below the posterior part of the bladder.

In females the vagina and uterus are situated between the bladder and rectum; so that the connexion of these last mentioned parts is very different in the two sexes.

The peritoneum is reflected at the anterior part of the brim of the pelvis from the abdominal muscles, which it lines, to the upper part of the bladder, which is generally contiguous to the brim of the pelvis. It continues over to the posterior side of the bladder, and passes down upon it some distance towards the lower part; but before it has arrived at the bottom, it is reflected towards the sacrum.

In males it extends from the bladder to the rectum, and in females, to the vagina and uterus; so that there is a considerable portion of the lower part of the bladder which is not invested by the peritoneum. It also follows that when the bladder is extended into the abdomen, and rises above the brim of the pelvis, that part of it which presents anteriorly, and is in contact with the abdominal muscles, is without a covering of peritoneum, being below it.

The bladder is composed of a coat consisting of muscular fibres, of a stratum of cellular substance immediately within this, and of an internal lining mem-

brane, which has been called villous; but, as there are no villi perceptible on it, it may be more properly denominated mucous.

It should be observed, that, in addition to these coats, the bladder has a peculiar investment of the peritoneum, as has been already described; and also of the common cellular membrane, which is placed between it in every part to which it is contiguous.

The *Muscular Coat of the Bladder* consists of fibres which are not spread over it of a uniform thickness, but are thin in some places, and in others are collected in fasciculi. They run in every direction: some appear longitudinal, others circular, and some oblique; and there are interstices between them which are occupied by cellular membrane. The longitudinal fibres originate from the lower part of the bladder; and as this is the fixed part of that viscus, it is the place from which these fibres must necessarily act. These fibres are generally exterior. There is no arrangement of muscular fibres to which the term of sphincter can properly be applied; but many anatomists have thought that the fibres near the neck of the bladder, by their separate contraction, might prevent the escape of urine; this sentiment, however, is contrary to that of several very respectable writers.

The direction of the fibres, taken collectively, is such, that, when they all contract, the cavity of the bladder is completely obliterated.

The cellular substance between the muscular and internal coats is dense. It yields in a remarkable manner to distention, and recovers its original dimensions very easily. From its analogy to a similar coat in the intestines, it is called the *Nervous Coat.*

The *Internal Coat* of the bladder is of a light colour in the dead subject, when it has been free from

disease. It had been called villous improperly; for the villous structure is not apparent upon its surface. Being continued from the integuments of the body which are extended along the urethra, it has been inferred, that the surface of this coat was formed by the epidermis; and some respectable authors have supposed that they had seen cases in which portions of the epidermis of the bladder had separated and been discharged; but these appearances are very equivocal, and it is by no means certain that an epidermis exists there.*

The fasciculi of fibres of the muscular coat occasion this coat to appear very irregular, but these irregularities correspond exactly with the arrangement of the fibres of the muscular coat.

When the internal coat is separated by dissection from the muscular, its surface is very smooth and uniform. In the recent subject, when no disease has previously existed, it is *always* spread over with mucus of a light colour, but nearly transparent, which can be easily scraped off. This mucus is spread upon the surface so uniformly, that it must be derived from sources which are situated upon every part of the surface; but these sources are not very obvious. On the membrane of the nose the orifices of many mucous ducts are very visible, but such orifices are not to be seen on this surface.—Haller mentions that he has seen mucous glands near the neck of the bladder; and it is stated by the pupils of Desault, that, in one of his courses, he pointed out a number of these glands, in a subject who had been afflicted with a catarrhal affection of the bladder.

* In the fauces and the follicles of the tonsils, an effusion of coagulable matter, in consequence of inflammation, often forms crusts, that may be mistaken for sloughs of the integuments, although these integuments remain entire.

Notwithstanding that the sources of this mucus are obscure, the quantity of it is sometimes immense. In some cases, where the secretion is increased by the irritation of a *calculus* in the bladder, the urine is rendered somewhat viscid and white coloured by the mucus mixed with it; which, after the urine has been allowed to remain for some time, subsides in such quantities as demonstrates that many ounces must be secreted in the course of the twenty-four hours. The same circumstances occur without the irritation of calculus, in the disease called catarrhus vesicæ.*

It is probable that, in healthy persons, a great deal of it passes off unperceived, being dissolved or diffused in the urine. From the quantity and the regular diffusion of this mucus on the surface of the bladder, there is the greatest reason for believing that it is effused from every part of the surface; and it is a question that has not been decided whether it is discharged from glandular ducts too small to be perceived, or from the exhalent extremities of the blood vessels. It is probable that the use of it is to defend the internal coat of the bladder from the acrimony of the urine.

The symptoms of a stone in the bladder, as well as of several other diseases, evince that this coat is endued with a great degree of sensibility.

It is evident that the essential parts in the general structure of the bladder are the muscular coat and the internal coat last described: but in addition to this account of them, there are some other important circumstances to be noted in the description of this organ. It has been already stated, that the form of the bladder was an irregular oval, although it was somewhat varied in different persons. The oval form is not

* In some cases this mucus soon becomes putrid, and during the putrefactive process deposites a substance which appears to be calcarious.

much altered at the part called the neck of the bladder, where the urethra passes off from it. The orifice of the urethra is situated *anteriorly* at the lowermost part of the bladder. On the lower surface of the urethra, at its commencement, and on the bottom of the bladder, immediately connected with the urethra, is situated the *Prostate Gland,* (to be hereafter described with the organs of generation,) which is a firm body, that adheres strongly both to the bladder and urethra. This circumstance gives particular firmness and solidity to that part of the bladder. It has also been observed, that the bladder is attached firmly to the ossa pubis, at its neck, about the origin of the urethra. Each of these circumstances has an effect upon the orifice of the urethra; and when the bladder is opened, and this orifice is examined from within, it appears to be kept open by the connexion of the bladder with the prostate, and has been very justly compared to the opening of the neck of a bottle into the great cavity of that vessel.*

The orifices of the two ureters are at equal distances from the orifice of the urethra, and form with it the angles of a triangle. That part of the internal surface of the bladder which is within this triangular space, is more smooth than the remainder of the same surface, probably in consequence of the adhesion of the bladder to the prostate, and to other parts exterior to it.

That part of the bottom of the bladder, which is

* The late M. Lieutaud, and after him the French anatomists of the present day, have described a small tubercle at the lower and posterior part of the orifice of the urethra, which resembles the uvula in form. It has not been noticed here; and M. Boyer states, that it is often scarcely perceptible. He, however, makes a remark which is very worthy of attention, namely, that it is very subject to enlargement in old people, forming a tumour which impedes the discharge of urine. Sabatier has also made the same observation.

immediately behind the triangular space, is rather lower than this space; and but a small portion of cellular membrane exists between it and the rectum in males, and the vagina in females.

The upper part of the bladder is connected with the umbilicus by means of a ligament, which passes between the peritoneum and the abdominal muscles. This ligament consists of three cords. One of these, which is in the middle, arises from the coats of the bladder, and was, in the fœtus, the duct called urachus; the other two, which are connected to the bladder, principally by cellular membrane, were originally the umbilical arteries.* The middle cord is of a light colour and fibrous structure; it is thickest at the bladder, and gradually diminishes as it approaches the umbilicus. In a few instances it has been found to be hollow. In its progress to the umbilicus it becomes more or less blended with the linea alba or the tendons of the abdominal muscles. The other cords are generally solid. After passing from the umbilicus to the bladder they continue on the sides of that viscus, and finally terminate at the hypogastric or internal iliac artery.

In the very young subject these cords are invested by distinct processes of the peritoneum, but their position is exterior to the peritoneum.

As the bladder is situated very near most of the large ramifications of the hypogastric artery in the pelvis, it receives branches from several of them; viz. from the umbilical arteries before they terminate; from the pubic; from the obturators, &c. These branches ramify in the cellular membrane exterior to the muscular coat, and also in the cellular substance between the muscular and internal coats. It

* See the accounts of these parts in the description of the Abdomen of the Fœtus.

has been *conjectured*, that their termination in exhalents on the surface of the bladder are remarkably numerous.

The veins correspond with the arteries, but they are very numerous on the lower and lateral parts of the bladder, and by uniting with the veins of the rectum form a remarkable plexus.

The *Lymphatic Vessels* of this organ do not appear more numerous than those of other parts. They pass on each side of the bladder in the course of its blood vessels, and unite with the larger lymphatics, and the glands which lie upon the great blood vessels on the sides of the pelvis.

The *Nerves* of the bladder are derived both from the intercostal nerve and from the nerves of the medulla spinalis, which pass off through the sacrum; and therefore the bladder is more affected than the viscera of the abdomen, by injuries of the medulla spinalis.

The action of the muscular fibres of the bladder in expelling urine, and the effect of those fibres which are situated near the orifice of the urethra in retaining it, can be considered with more advantage after the structure of the urethra and the muscles connected with that canal have been described.

It has been stated, that the internal coat of the bladder is very sensible; but it may be added, that in consequence of disease about the neck of the bladder, the natural sensibility appears most inordinately increased. When the intensity of pain which accompanies these complaints, the frequent recurrence of paroxysms, and their duration, are taken into view, there seems reason to believe that none of the painful affections of the human race exceed those which arise from certain diseases of the bladder. Happily these diseases are not very common.

The functions of the kidneys is to secrete urine, and that of the bladder to retain it, until the proper time for evacuation.

The urine may be regarded as an excrementitious fluid, which contains many substances in solution that are constantly found in it, and many others that are occasionally in it, which are taken as aliment or medicine, and pass to the bladder with little, if any change. The odour of the rose leaf, the colour of rhubarb, &c. are occasionally perceived in urine.

The substances constantly found in urine are numerous. The chemical account of the subject is so long that it cannot be detailed here; but the student ought to make himself acquainted with it, and he will read with great advantage Johnson's History of Animal Chemistry, vol. 2d, page 363; and also Thomson's Elements of Chemistry, page 333.

CHAPTER V.

OF THE MALE ORGANS OF GENERATION.

These organs consist first of the *Testicles*, and their appendages.

2d. Of certain parts denominated the *Vesiculæ Semenales* and the *Prostate Gland*, which are situated near the commencement of the urethra, and are subservient to the purposes of generation.

3d. Of the *Penis*.

SECTION I.

Of the Testicles and their Appendages.

The *Testicles* are two bodies of a flattened oval form. Each of them has a protuberance on its upper and posterior part called *Epididymis*, and is connected to parts within the cavity of the abdomen by a thick cord, which proceeds through the abdominal ring. Each testicle also appears to be contained in a sac, which is suspended by this cord and covered by the common integuments.

That portion of the common integuments which forms the external covering of the testicles, is denominated,

The Scrotum.

The skin of the scrotum, although it is very often in a state of corrugation, has the same structure with that on other parts of the body, except that it is ra-

ther thinner and more delicate. The superior delicacy of this portion of the skin is evinced by the great irritation produced by the application of stimulating substances, and the desquamation of the cuticle, which seems to be the effect of irritation. There are many sebaceous follicles in this portion of skin; and after puberty there are often a few long hairs growing out of it, the bulbs of which are often very conspicuous. There is a small raised line in the middle of this skin, which commences at the root of the penis, and proceeds backwards, dividing it into two equal parts: this line is denominated *Raphe.*

The corrugation which so often takes place in the skin of the scrotum, appears to be occasioned by the contraction of certain fibres, which are in the cellular substance immediately within it. This cellular substance appears to be attached in a particular way to the skin; and it also invests each testicle in such a manner, that when they are withdrawn, a cavity is left in it. It has long been observed, that no adipose matter is found in this cellular substance: but it is often distended with water in hydropic diseases. As the contraction and corrugation of the scrotum has been imputed to this substance, it has been examined with particular attention by anatomists, and very different sentiments have been entertained respecting it. While some dissectors have asserted that muscular fibres could be seen in it, which they have denominated the *Dartos Muscle;* others have said that this substance was simply cellular, and without any muscular fibres. This difference of sentiment may possibly have arisen from the different conditions of this part in different subjects; for in some cases there are appearances which seem to justify the assertion that muscular fibres exist in this structure.

After the testicles are removed, so as to leave the

cellular substance, connected with the skin, if the scrotum be inverted, and this substance examined in a strong light, many fibres will appear superadded to the common cellular structure; and sometimes their colour can be distinguished to be red. It is not asserted that this will be uniformly the case; but certainly it has often been observed in this way.

The existence of an organ which possesses the power of contraction, within the skin of the scrotum and connected to it, is evinced by the corrugation which takes place when the scrotum is suddenly exposed to cold, after having been very warm. This corrugation occurs in a very sudden and rapid manner, in some cases, in which the wounded scrotum is thus exposed for the purpose of dressing: for example, upon removing an emollient poultice from this part some days after the operation for the cure of hydrops testis, by incision, if the air of the chamber be cool, a motion of the scrotum will take place, almost equal to the peristaltic movements of the intestines.

The *Arteries* of the scrotum are derived from two sources. One or two small arteries, which arise from the femoral artery, between Poupart's ligament and the origin of the profunda, are spent upon it. These are called the external pudic arteries. It also receives some small branches from the internal pudic artery.

The *Nerves* of the scrotum are principally derived from the lumbar nerves.

The Spermatic Cord.

The cord which proceeds to the testicle, through the abdominal ring, appears at first view like a bundle of muscular fibres; but it consists of an artery and veins with many lymphatic vessels and nerves, and also the excretory duct of the testicle, connected to

each other by cellular substance, and covered by an expansion of muscular fibres which are derived from the lower edge of the internal oblique muscle of the abdomen, and continue from it to the upper part of the testicle. These fibres constitute the *Cremaster Muscle.*

The artery above mentioned is called the *Spermatic.* It commonly arises from the front of the aorta, very near its fellow, at a small distance below the emulgents, and is not much larger than a crow's quill. It proceeds downwards behind the peritoneum and before the psoas muscle and ureter.—While it is in contact with the psoas muscle, it joins the ramifications of the vein. It afterwards meets the vas deferens, and proceeds through the abdominal ring to the back part of the testis. Before it arrives at the testis, it divides into several branches, two of which generally go to the epididymis, and the others penetrate the tunica-albuginea on the upper and back of the testicle, and ramify very minutely on the fine membranous partitions which exist in that body.

In addition to the spermatic artery, there is a small twig from the umbilical branch of the hypogastric, which passes to the spermatic cord along the vas deferens.

The branches of the spermatic vein are much larger than those of the artery: several of them proceed from the testicle so as to correspond with the arterial branches; and in addition to these there are many smaller, which also arise from the testicle and epididymis. In their course up the cord they ramify, and again unite so as to form a considerable plexus, which is called the *Corpus Pampiniforme,* and constitutes a considerable part of the volume of the spermatic cord.

As they proceed upwards, they unite into a few larger veins; and finally, on the psoas muscle, they

generally form one trunk, which continues upwards so as to unite with the vena cava on the right side, and the emulgent vein on the left.

Sometimes, but not often, there are several spermatic veins on each side.

The *Lymphatic Vessels* of the testicle are very numerous, considering the size of the organ. Six or eight, and sometimes more, large trunks have been injected, running upon the cord, and continuing to the glands on the back part of the abdomen.

The *Nerves* of the testicle are derived from those which supply the viscera of the abdomen, and are to be found in the cord, although they can scarcely be traced to the testicle. A small plexus, called the spermatic, is formed by fibres from the renal plexus, and from the symphathetic nerve. These fibres accompany the spermatic vessels, and in all probability enter the body of the testis and the epididymis. The spermatic cord and cremaster muscle receive filaments from the second lumbar nerve.

In addition to these vessels, the *Vas Deferens*, which is much firmer than either of them, is always to be distinguished in the back part of the cord.

They are all covered in front and on the sides by the cremaster muscle, which passes with them from the lower margin of the internal oblique, through the abdominal ring, and continues to the upper part of the external coat of the testicle, which is a sac apparently containing that organ, and upon this sac it is spread out and terminates.

The Tunica Vaginalis.

The *External Coat* of the testicle, which is commonly called the *Tunica Vaginalis*, is a complete sac which encloses the testicle as the pericardium encloses the heart. It covers the body of the testicle

and epididymis, and adheres closely to them. It is then reflected from them so as to form a loose sac, which appears to contain them. The cavity of the tunica vaginalis commonly extends above the body of the testis up the cord, and is oval or pyriform.—This sac is so reflected from the body of the testicle that there is a place on the upper and back part of that body, at which the blood vessels enter it, without penetrating the sac.

It resembles the peritoneum and other serous membranes in texture, and is therefore thin and delicate. It always contains a quantity of moisture, sufficient to lubricate the surface which it forms.

When the tunica vaginalis is laid open, the testicle appears as if it were contained in the posterior part of its cavity.

The testicles, as has been already stated, are of a flattened oval form. Their position is somewhat oblique, so that their upper extremities look upwards and forwards, their lower extremities downwards and backwards, and their edges present forwards and backwards.

The body of the testicle is very firm, in consequence of its enclosure in a very firm coat called *Tunica Albuginea.* Upon the upper and posterior part of it is the protuberant substance, called *Epididymis,* which is less firm, being exterior to the tunica albuginea. The blood vessels of the testicle pass into it on the posterior edge, at some distance below the upper end.

The Tunica Albuginea,

In which the body of the testicle is completely enclosed, is firm and dense; and upon this coat its particular form depends. It is of a whitish colour, and has a smooth external surface. It is thick as well as strong. The epididymis is exterior to it.

It is only perforated by the blood vessels, lymphatics and nerves, and by the vasa efferentia, which carry out the secretion of the testis. One portion of the tunica vaginalis adheres very closely to it, and the other appears to contain it. The portion which adheres to it is with difficulty separated, but it is a distinct membrane.

The Epididymis

Differs in colour from the testicle, being more or less reddish. It commences at the upper and anterior extremity of the testicle, and passes down the posterior edge to the lower end.

At the commencement the epididymis is somewhat rounded in form, and its upper part, or head, has been called the globus major: as it descends it lessens, and about the middle of the testicle it is flattish.

It is firmly attached to the body of the testicle, at the upper end, where the vasa efferentia pass to it; and it is also attached to it below; but at the middle it appears nearly detached from it. It has therefore been compared to an arch resting with its two extremities on the back of the testis; it is, however, in contact with it at its middle; but about the middle it only adheres by one of its edges to the body of the testis, and generally by its internal edge. It has a coat which is less firm than the tunica albuginea of the testicle, described on the last page. The tunica vaginalis of the testicle is so reflected as to cover a great part of the epididymis which is not in contact with the testicle, and also those surfaces of the epididymis and testis which are in contact with each other and do not adhere.

The Body of the Testicle.

When the tunica albuginea is cut through, and the substance of the testicle examined, it appears to consist of a soft pulpy substance of convoluted threads, of a yellowish brown colour, which is divided into separate portions by very delicate septa, attached to the internal surface of the tunica albuginea at the posterior part of the testicle. After maceration, by using a fine needle to detach them from the cellular substance, these threads may be drawn out to a great length. In some animals they are larger than in the human species; in them, it is said, they are evidently hollow, and that very small blood vessels appear in their coats. When mercury is injected into the vas deferens, or excretory duct of the testis, in a retrograde course, it can be perceived in these ducts in the human subject.

These delicate septa, or partitions, are united to the internal surface of the tunica albuginea at the posterior part of the testicle, at which place there is a body called *Corpus Highmorianum,* which has been regarded very differently by different anatomists. It is a long whitish substance, which extends lengthwise on the posterior part of the testis; and was supposed by Haller to resemble one of the salivary ducts. It is now, however, generally agreed to be of a cellular structure, and to contain and support the ducts which pass from the substance of the testicle to the epididymis.

The blood vessels pass into the body of the testicle upon these septa, and are continued from them to the filaments or tubes of which the body of the testicle consists. As in some animals blood vessels are distinguished on these tubes, there is the greatest reason to believe that a direct communication subsists between them, without the intervention of any other structure,

no other structure having been discovered: but at the same time it ought to be observed, that these tubes have not yet been injected from the blood vessels. Some ingenious anatomists have injected the artery going to the testicle so successfully that the injection has passed from it into the veins coming out of the testicle; but it is not now said by any of them, that they have filled the tubes in this manner.

Mercury will pass into these vessels from the excretory duct of the testicle; and by means of an injection in that way, the structure of the testicle can be unravelled.

This structure is as follows: The cavity formed by the tunica albuginea is divided into a number of apartments by the very thin septa or partitions above mentioned. From the filamentary or tubular matter which fills each of these chambers, proceeds a number of small tubes or vessels, which observe a straight course; they are, therefore, called *Vasa Recta.* These vasa recta unite with each other and form a net-work on the back of the testis, within the tunica albuginea, which is called *Rete Testis.* From this net-work other vessels, from twelve to eighteen in number, denominated *Vasa Efferentia,* proceed through the albuginea to the epididymis. These vessels are convoluted in such a manner as to form bundles of a conical form, which are called *Coni Vasculosi.* The number of these corresponds with the number of the vasa efferentia, and they compose about one-third of the epididymis, viz. all the upper part of it. The single tubes which form each of these cones, successively unite into one duct, which is convoluted so as to form all the remainder of the epididymis. The lower part of the epididymis is turned upwards on the back of the testicle, the tube gradually enlarges and is less convoluted, and finally becomes straight: it then takes

the name of *Vas Deferens*, and continues on the back of the testicle and at the inner side of the epididymis to the spasmodic cord.*†

A small solitary vessel or duct, has been observed by Haller, Monro, and several other anatomists, to proceed from the upper part of the epididymis: sometimes it unites to the epididymis below, and sometimes it proceeds upwards. The nature of this vessel has not been ascertained with certainty.

The Vas Deferens

Is a very firm tube, about one line in diameter, which is not perfectly cylindrical exteriorly, although the cavity formed by it is so. This cavity is so small in diameter, that it will only admit a fine bristle. The coats of the duct have, of course, a considerable thickness. The internal coat forms a soft surface, analogous to that of the mucous membranes: the external is firm, and its texture resembles that of cartilage. Owing to the small size of the cavity, the internal coat has not been separated from the external.

* De Graff appears to have been the first anatomist who made much progress in the successful investigation of the structure of the testicle; and Haller ought to be mentioned next to him, on account of the plate exhibiting this structure, and the explanation of it, which he published in the Philosophical Transactions of London, for 1749. This plate has been republished by the second Monro, in the Literary and Physical Essays of Edinburgh, and also in his Inaugural Thesis. Haller has likewise republished it in his Opera Minora. It represents not only the vasa efferentia, and the cones formed by their convolutions, but also the rete tesis, and the vasa recta. Haller could inject no farther than this; but Monro and Hunter soon after succeeded so as to fill a considerable portion of the body of the testicle with mercury, injected by the vas deferens.

† In Mr. Charles Bell's Anatomical Collection in London, there is a preparation by his assistant, Mr. Shaw, in which the tubuli testis are completely injected with quicksilver and unravelled. I saw also in Leyden, one nearly as successfully executed by Professor Sandifort.—Ed.

It passes upwards in the posterior part of the spermatic cord, and continues with it through the abdominal ring, under and exterior to the peritoneum; soon after this it leaves the cord and dips down into the cavity of the pelvis, forming a curve on the side of the bladder, and proceeding backwards, downwards, and inwards. In this course it crosses the ureter, and passes between it and the bladder. On the lower part of the bladder the two vasa deferentia approach each other so gradually that they appear to be nearly parallel. They proceed forward between the vesiculæ seminales, which are two bodies irregularly convoluted, that are placed in a converging position with respect to each other, and communicate with the vasa deferentia. The vasa deferentia finally terminate almost in contact with each other in the posterior part of the prostate gland, where they perforate the urethra. At the distance of about two inches and a half from their termination they enlarge in diameter, and become somewhat convoluted. At the posterior margin of the prostate they come in contact with the anterior extremities of the vesiculæ seminales, and unite with them. After this union they diminish in size, and become conical; and passing a short distance through the substance of the prostate, during which they approach each other more rapidly, they penetrate the urethra, so as to open in it on each side of a small tubercle, called the *Caput Gallinaginis*, soon to be described.

SECTION II.

Of the Vesiculæ Seminales and the Prostate Gland.

The *Vesiculæ Seminales* are two bodies of a whitish colour, and irregular form, being broad and flat at their

posterior extremities, and terminating in a point at the other. Their surfaces are so convoluted, that they have been compared to those of the brain. They are situated between the rectum and bladder, and are connected to each by cellular membrane.

When the vesiculæ seminales are laid open by an incision, they appear to consist of cells of a considerable size, irregularly arranged; but when they are carefully examined exteriorly, and the cellular membrane about them is detached and divided, they appear to be formed by a tube of rather more than two lines diameter and several inches in length, which terminates, like the cæcum, in a closed extremity. From this tube proceed from ten to fifteen short branches, which are closed in the same manner. All these tubes are convoluted so as to assume the form of the vesiculæ seminales above described; and they are fixed in this convoluted state by cellular membrane, which firmly connects their different parts to each other. It is obvious that tubes thus convoluted, when cut into will exhibit the appearance of cells, as in the present instance.

This convoluted tube composing the vesiculæ seminales, terminates in a very short duct, which is nearly of the same diameter with the vas deferens, and this duct joins the vas deferens so as to form an acute angle.

From the union of the vesiculæ seminales with the vas deferens on each side, a canal, which seems to be the continuation of the vas deferens, proceeds through part of the prostate to the urethra, which it perforates. These canals are from eight to twelve lines in length; they are conical in form, their largest extremity being equal to the vas deferens at that part.

If air or any other fluid be injected through the vas deferens into the urethra, it will pass at the same

time into the vesiculæ seminales, and distend them. It has been observed, that a fluid passes in this manner much more readily from the vasa defferentia into the vesiculæ seminales, than it does from these last mentioned organs into the duct.

These organs were generally regarded as reservoirs of semen, and analogous to the gall bladder in their functions, until the late Mr. J. Hunter published his opinion that they were not intended to contain semen, but to secrete a peculiar mucus subservient to the purposes of generation.

He states the following facts in support of his opinion.

A fluid, very different from semen, is found after death in the vesiculæ seminales.

In persons who have lost one testicle, a considerable time before death, the vesiculæ seminales on each side are equally distended with this peculiar fluid. In the case of a person who had a deficiency of the epididymis on one side, and of the vas deferens on the other, the vesiculæ were filled with a peculiar fluid!

The sensation arising from redundance of the secretion of the testis, is referred to the testes, and not to the vesiculæ seminales.

In some animals there is no connexion between the vasa deferentia and the vesiculæ seminales.

See Observations on certain Parts of the Animal Economy, by John Hunter.

The Prostate Gland

Is situated on the under and posterior part of the neck of the bladder, so as to surround the urethra. Its form has some resemblance to that of the chesnut, but it has a notch on the basis like that of the figure of the heart on playing cards, and it is much larger than the chesnut of this part of America. The basis

of this body is posterior, and its apex anterior; its position is oblique, between the rectum and the symphysis pubis. Below there is in some cases a small furrow, which, in addition to the notch above, gives to the gland an appearance of being divided into two lobes. By turning away the vesiculæ seminales and vasa deferentia from the under surface of the bladder, we bring into view a small tubercle at the upper part of the base of the prostate, called by Sir Everard Home the third lobe. When diseased it projects into the cavity of the bladder.

It adheres to the urethra and neck of the bladder. Its consistence is very firm and dense, resembling the induration of scirrhus rather more than the ordinary texture of glands.

This gland receives small branches from the neighbouring blood vessels, and has no artery of considerable size exclusively appropriated to it.

As it lies in close contact with the urethra, the ducts which pass between it and the urethra are not to be seen separate from these bodies: but ducts can be seen in the substance of the gland, which perforate the urethra, and open on the sides of the caput Gallinaginis to the number of five or six on each side. By pressure a small quantity of a whitish fluid can be forced from these orifices, which is rather viscid, and coagulable in alcohol.

The particular use of this fluid is not known.

SECTION III.

Of the Penis.

The penis, when detached from the bladder, and the bones, to which is is connected, and divested of the skin which covers it, is an oblong body, which is rounded at one extremity and bifurcated at the other.

It is composed of three parts, namely, two oblong bodies, called *Corpora Cavernosa*, which, at their commencement, form the bifurcated portions, and then unite to compose the body of the organ; and a third part, of a spongy texture, which is connected to these bodies where they unite to each other, on the under side, and continues attached to them during the whole extent of their union, terminating in an expanded head which covers the anterior extremities of the corpora cavernosa. The urethra passes from the neck of the bladder, on the under side of the penis, to its anterior extremity, invested by this third body, which is therefore called *Corpus Spongiosum Urethræ.*

The two bifurcated extremities are attached each of them to one of the crura of the pubis and ischium; and they unite to form the body of the penis immediately anterior to the symphysis pubis, to which the lower part of it is also attached; so that the penis is firmly connected to the middle of the anterior part of the pelvis. The urethra proceeds from the neck of the bladder, between the crura of the ischium and pubis and the crura of the penis, to join the body of the penis at its commencement, and near this place its connexion with the corpus spongiosum begins; so that there is a small portion of the urethra between the neck of the bladder and the commencement of the corpus spongiosum, which is not covered by the corpus spongiosum. This is called the membranous part of the urethra.

The penis, therefore, consists of two oblong bodies of a cellular structure, which originate separately, but unite together to form it; and of the urethra, which joins these bodies immediately after their union, and is invested by a spongy covering, which by its expansion forms the anterior extremity not only of the urethra, but of the whole penis. These three bodies, thus ar-

ranged and connected, are covered by cellular membrane and skin in a manner to be hereafter described.

The Corpora Cavernosa,

Which compose the body of the penis, are two irregular cylinders, that are formed by a thick dense elastic membrane, of a whitish ligamentous appearance and great firmness. They are filled with a substance of a cellular structure, which is occasionally distended with blood. The crura of these cylindrical bodies, which are attached to the crura of the ischium and pubis, are small and pointed at the commencement, and are united to the periosteum of the bones. In their progress upwards they enlarge, and at the symphysis of the pubis they unite so as to form an oblong body, which retains the appearance of a union of two cylinders applied to each other lengthways; for above there is a superficial groove passing in that direction, which is occupied by a large vein: and below there is a much deeper groove, in which the urethra is placed. Between these grooves is a septum which divides one side of the penis from the other. It appears to proceed from the strong membrane which forms the penis, and is composed of bundles of fibres, which pass from one groove of the penis to the other, with many intervals between them, through which blood or injection passes very freely. Sometimes these bundles of fibres, with their intervals, are so regularly arranged, that they have been compared to the teeth of a comb. This septum extends from the union of the two crura to their termination.

Each of these cylinders is penetrated by the main branch of the pudic artery, which is about equal in size to a crow's quill. These arteries enter the corpora cavernosa near their union, and continue through

their whole extent, sending off branches in their course; the turgescence and erection of the penis is unquestionably produced by the blood which flows through these vessels into the penis.

The interior structure of the penis, when examined in the recent subject, is of a soft spongy nature, and seems stained with blood. If any fluid be injected through the arteries this substance appears cellular, and may be completely distended by it. When air is injected, and the structure becomes dry, the penis may be laid open; the cellular structure then appears as if formed by a number of lamina and of filaments, which proceed from one part of the internal surface of the penis to another, and form irregular cells. It has been compared to the lattice-work in the interior of bones; and it is suggested by M. Roux, that the fibres of which the structure consists resemble those of the strong elastic coat of the penis.* If these cells are filled with coloured wax, injected by the artery, and the animal substance is then destroyed by placing the preparation in a corroding liquor, the wax which remains shows that the membranes forming the cells are very thin.

These cells communicate freely with each other; and, therefore, if a pipe be passed through the strong coat of the penis, the whole of them can be filled from it by the ordinary process of injection.

* Mr. John Hunter says on this subject, " That the cells of the corpora cavernosa are muscular, although no such appearance is to be observed in men: for the penis in erection is not at all times equally distended. The penis, in a cold day, is not so large in erection as in a warm one; which probably arises from a kind of spasm, that could not act if it were not muscular.

In the horse, the parts composing the cells of the penis appear evidently muscular to the eye, and in a horse just killed, they contract upon being stimulated.—Ed.

The Urethra

Is a membranous canal which extends from the neck of the bladder to the orifice at the extremity of the penis; and for a very great part of its length is invested by a spongy structure. called the corpus spongiosum urethræ. It proceeds from the neck of the bladder along the upper part of the prostate; from the prostate it continues between the crura of the penis until their junction: it then occupies the great groove formed by the corpora cavernosa on the lower side of the penis, and continues to the orifice abovementioned. At a small distance from the prostate gland the spongy substance which invests it commences, and continues to its termination. After this spongy substance has arrived at the termination of the corpora cavernosa, it expands and forms a body of a particular figure which covers the extremities of the corpora cavernosa, and is denominated the *Glans Penis*.

The *Corpus Spongiosum* begins at the distance of eight or ten lines from the anterior part of the prostate. It is much larger at its commencement than at any other part except the glans, and this enlarged part is called the *Bulb*. It surrounds the whole of the urethra, and, with the exception of the bulb and the glans penis, is of a cylindrical figure. It is formed by a membrane which has some resemblance to the coat of the penis, but is much thinner, and by a peculiar spongy substance, which occupies the space between the internal surface of this membrane and the external surface of the canal of the urethra. The membrane and the spongy substance, form a coat to the urethra, which, with the exception of the enlargement before mentioned, is about one line thick. After this spongy substance has arrived at the termination, its coat adheres firmly to the coat of the penis.

The *Bulb,* or first enlargement of the corpus spongiosum, is oblong, and rather oval in form; it is marked by a longitudinal depression in the middle, which is very superficial. It consists entirely of the spongy substance above mentioned.

The *Glans Penis* is also composed of the same spongy substance, but the coat which covers it is more thin and delicate than that of the other parts of the urethra. The lower surface of the glans is fitted to the extremities of the corpora cavernosa, but it is broader than the corpora cavernosa, and therefore projects over them on the upper and lateral parts of the surface of the penis. The edge of the prominent part is regularly rounded, and is denominated the *Corona Glandis.*

Several small arteries pass to this spongy structure. The pudic artery, as it passes on each side to the corpora cavernosa, sends a branch to the bulb of the urethra. The same vessel, in the substance of the penis, also sends branches to the urethra; and the artery on the back of the penis terminates in small branches, which penetrate the substance of the glans.

By these vessels blood is carried to the spongy substance of the urethra, which is occasionally distended in the same manner that the cavernous bodies of the penis are distended during the erection of that organ. But the cellular structure of this organ is not so unequivocal as that of the corpora cavernosa; for if it be injected with coloured wax, and corroded in the usual manner, the injected matter will exhibit an appearance which has the strongest resemblance to a convoluted vessel, like the vas deferens in the epididymis.*

*Mr. Hunter says, "that the corpus spongiosum urethræ and glans penis are not spongy or cellular, but made up of a plexus of veins. This structure is discernible in the human subject; but is much more distinctly seen in many animals, as the horse," &c.—Ed.

The Canal of the Urethra,

Which conveys the urine from the bladder, is a very important part of the urinary organs. It consists of a vascular membrane with a smooth surface, which is perforated by the orifices of many mucous follicles, some of which are of considerable size. It is extremely sensible, and has so much power of contraction, that some persons have supposed muscular fibres to exist in its structure.

It is differently circumstanced in different parts of its course. While surrounded with the prostate it adheres firmly to that body, seeming to be supported by it; and here its diameter is larger than it is farther forward. On the lower or posterior side of this portion of the urethra, is an oblong eminence, called *Verumontanum*, or *Caput Gallinaginis*, which commences at the orifice of the urethra, and continues throughout the whole portion that is surrounded by the prostate gland, terminating at the point of that body. The posterior extremity of this tubercle begins abruptly, and soon becomes thick and large; anteriorly it gradually diminishes to a line, which is sometimes perceptible for a considerable distance in the urethra, in a straight forward direction. In the upper edge or top of this body is a groove, which is produced by a mucous follicle; on the lateral surfaces, anterior to the middle, are the orifices of the common ducts of the vesiculæ seminales, and vasa deferentia, (see page 182,) which are sufficiently large to receive a thick bristle. Near these, on each side, are five or six smaller orifices of the excretory ducts of the prostate gland. At the distance of an inch before the extremity of the bulb of the urethra, in the lining membrane, are the openings of two ducts, one on each side, that lead to small glandular bodies called Cowper's glands, which are situated on each side of the

urethra below the bulb, but are covered by the accelerators urinæ muscles.

The diameter of the urethra lessens after it leaves the prostate. That portion of the canal which is between this gland and the bulb, without investment, and therefore called the membranous part, is the smallest in diameter.

After it is invested with the spongy substance, it has a small enlargement, and then continues nearly of one size, until it arrives near the glans penis, when it again enlarges and alters its form, being no longer cylindrical, but flattened. Its broad surfaces have now a lateral aspect.

From the bulb of the corpus spongiosum to this last enlargement, the appearance of the inner surface of the urethra is uniform. The membrane is thin and delicate, and in a healthy subject, who has been free from disease of these parts, is of a whitish colour; but blood vessels are very perceptible in it. When it is relaxed, it appears to be thrown into longitudinal wrinkles; but it admits of considerable extension; being somewhat elastic: when extended, its surface appears smooth, as if it were covered with an epithelium. Mr. Shaw, of London, has described a set of vessels immediately below the internal membrane of the urethra, which, when empty, are very similar in appearance to muscular fibres. He says he has discovered that these vessels form an internal spongy body, which passes down to the membranous part of the urethra, and forms even a small bulb there. His preparation with a quicksilver injection of the part is certainly a very satisfactory proof of its existence.* Throughout the whole extent of this part of the urethra, are the orifices of a great many mucous ducts or sinuses, which pass obliquely backwards. Many of these are

* See Med. Chirurg. Transactions of London.—vol. 10th.

so small that they cannot be penetrated by a bristle, or probe of that size; but some are larger. It has not been observed that any glandular body immediately surrounds them, although they secrete the mucus with which the urethra is lubricated. On the lower side of the urethra, near the commencement of the glans penis, there is one or more of them, so large that their orifices sometimes admit the point of a small bougie.*

These organs, when inflamed, secrete the puriform discharge which takes place in gonorrhœa.—In a natural state they produce the mucus which is constantly spread over the surface of the urethra, to defend it from the acrimony of the urine, and which passes away with that fluid unperceived.

The surface of the urethra is endued with great sensibility, and is therefore liable to great irritation from contact with any rough body or any acrid substance. Irritation, thus excited, induces a state of contraction, which is particularly remarkable, as no muscular fibres are to be seen in its structure. When a bougie has been passed into the urethra for a considerable distance, if it cannot proceed the whole way, it sometimes happens that the instrument will be discharged by a steady uniform motion, which seems to proceed from a progressive contraction of the urethra, beginning very low down. At particular times, after the urethra has been much irritated, it will not receive a bougie, although at other times a bougie of equal size may be passed to the bladder without opposition. This cannot depend upon that elasticity which was noticed before.†

* They were discovered by Plazzoni, of Padua, in 1621. Their number, according to Loder, amounts to about 65—See his plates.—Ed.

† Sir Everard Home, whose professional opinions are of great weight, has lately described in the Transactions of the Royal Society, the appearance of the lining membrane of the urethra, when viewed through a

Upon the two crura of the penis, or the beginning of the corpora cavernosa, are fixed the muscles called *Erectores Penis*, which are described in the first volume.* These muscles cover the crura of the penis from their origin to the junction, and not only compress them, but also influence the motion of the penis when it is distended.

The bulb of the urethra is covered by a muscular coat, called the *Accelerator Urinæ*,* which has the effect of driving forwards any fluid contained in the cavity of the urethra, and also of giving the same direction to the blood in that part of the corpus spongiosum. There is also the *Transversus Perinei* on each side, that passes transversely from the tuberosity of the ischium to the bulb of the urethra.—Finally, the lower part of the sphincter ani muscle, which is nearly elliptical in form, is inserted by its anterior point into the muscular covering of the bulb of the urethra. Upon removing the integuments, these muscles are in view; and the course of the urethra from the bladder is concealed, particularly by the anterior point of the sphincter ani. When the sphincter ani is dissected away from its anterior connexions, and the cellular and adipose substance, which is sometimes very abundant, is also removed, the lower surface of the membranous part of the urethra may be brought into view, as it proceeds from the prostate gland to the bulb of the corpus spongiosum.†

When the accelerator urinæ is removed from the bulb of the urethra, there will appear two bodies,

microscope of great powers. From this paper, it seems that he is fully convinced of its muscular structure.—Ed.

* See description of "Muscles about the Male Organs of Generation," Vol. I. Part II. Chap. II.

† The natural situation of the membranous part of the urethra, and of the prostate gland, as well as their relative position with respect to the sphincter ani, rectum, &c. can be best studied by a lateral view of the con-

which have some resemblance to flattened peas. They lie one on each side of the urethra, in contact or nearly so with its bulb, and from each gland proceeds an excretory duct of an inch and a quarter in length between the corpus spongiosum and the lining membrane of the canal of the urethra, and opens into the latter. Its orifice is found with some difficulty, but is large enough to admit a bristle. These are Cowper's glands.*

The penis is connected to the symphysis pubis by a ligamentous substance, which proceeds from the back or upper surface of the organ to the anterior part of the symphysis, and connects these parts firmly to each other.

Thus constructed, of the corpora cavernosa and the urethra with its corpus spongiosum, and attached to the pelvis as above mentioned, the penis is invested with its integuments in the following manner.†

tents of the pelvis; which is to be obtained by removing carefully one of the ossa innominata, and dissecting the parts which were enclosed by it.

* These glands were discovered by Mery, in 1684, and described by Cowper, in 1699. A third gland, smaller than the preceding, connected with the curve of the urethra under the symphysis pubis, was discovered by Cowper, and Morgagni speaks of having observed a fourth.—Ed.

† There are several fasciæ and ligaments about the perineum which should be connected with the account of its viscera. Immediately beneath the skin of the perineum is the Perineal Fascia, a thin but strong membrane, which extends from bone to bone, occupying the space between the anus and the posterior part of the scrotum. It is rather better seen in lean subjects than in fat ones, for in the latter it is converted in part into adipose membrane. When a rupture occurs in the posterior part of the urethra, this fascia prevents the urine from showing itself immediately in the perineum, and drives it into the cellular structure of the scrotum.

Immediately beneath the perineal fascia are placed the muscles; when they are removed, the bulb of the urethra may be seen very advantageously, extending in the middle of the perineum almost to the anus. It is

Integuments of the Penis.

The glans penis, the structure of which has been already described, is covered by a continuation of the skin which appears altered in its texture so as to resemble in some respects the skin of the lips, and in like manner is covered by a delicate production of cuticle.

Around the corona of the glans, especially on its upper part, there are whitish tubercles, which are of different sizes in different persons, but always very small. The skin adheres firmly to the whole extent of the corona of the glans, and is very delicate in its structure, as it continues from the glans upon the body of the penis; but it gradually changes so as to assume the appearance and structure of a common skin, and continues in this state over the penis. The adhesion of the skin to the ligamentous coat of the corpora cavernosa also becomes more loose; owing to the quantity and texture of the cellular substance which connects them. The skin, thus connected to the penis, has commonly more length than that organ, even in its extended state. In consequence of this greater length, and of its adhering firmly around the corona glandis, it necessarily forms a circular fold or plait,

not loose and pendulous, but is attached by its pelvic surface to the triangular ligament of the urethra. This ligament is a septum between the perineum and the pelvis, and connects itself to the pelvic or internal edges of the rami of the pubis and ischi as far down as the organs of the crura penis. It extends from the arch of the pubis to the line mentioned, and fills up all the space between the bones of the opposite sides. It consists of two lamina, and Cowper's glands are placed between them. About an inch below the symphysis pubis a perforation is made in this ligament for the passage of the membranous part of the urethra.

Just below the symphysis pubis, between the two lamina of the triangular ligament, is placed a much stronger ligament called the pubic, which is about half an inch broad, its lower edge is thick and rounded. For farther detail on the subject of the fasciæ of the pelvis, see Lessons in Practical Anatomy by the present editor.—Ed.

which varies in size according to the length of the skin. This fold is generally situated at the commencement of the firm attachment of the skin to the body of the penis, or around the glans; but it may be formed any where upon the body of the penis by artificial management.

This duplicature, or fold of the skin, when it takes place so as to cover the glans, is called the *Prepuce;* and the skin, which is very tender and delicate for some distance from the glans, forms that surface of the prepuce which is in contact with the glans when it covers that body.

There is also a small fold of the skin, which is longitudinal in its direction, that commences at the orifice of the urethra, and extends backwards on the lower surface of the penis. It is unvarying in its position, and is called the *Frenum.*

It is a general observation, that adeps is not found in the cellular substance which connects the skin to the body of the penis; but this cellular substance is distended with water in some hydropic cases.

From the skin immediately below the glans, and from small follicles on each side of the frænum, is secreted an unctuous fluid, which, when allowed to continue, becomes inspissated, and acquires a cascous consistence and colour, as well as as a peculiar odour. It sometimes also acquires an acrimony which produces inflammation on the surface with which it is in contact, as well as the copious secretion of a puriform fluid.

The distribution of the pudic artery in the penis has already been mentioned; and a farther account of its origin and progress to its destination, will be found in the general account of the arteries. Sometimes small branches of the external pudic arteries, which originate from the femoral, are extended to the penis; and it has been asserted, that branches of the middle

hæmorrhoidal artery have also been found there, but this does not often occur.

The *Veins* of the penis are of two kinds; those which originate in the corpora cavernosa, accompany the corresponding branches of the pudic artery, but communicate more or less with the plexus of veins on the lower and lateral part of the bladder. There is also a great vein, which occupies the groove on the back of the penis, between the corpora cavernosa, that appears particularly appropriated to the corpus spongiosum urethræ; for it originates in the glans penis, and receives branches from the urethra as it proceeds backwards. There are often two of these veins, one in the groove, and the other more superficial: they generally unite near the root of the penis. The common trunk then passes between the body of the penis and the symphysis pubis, and terminates in a plexus of veins at the neck of the bladder, which is connected to the plexus above mentioned on the lower and lateral parts of the same viscus.

The *Absorbent Vessels* of the penis take two different directions on each side. Those which arise from the integuments generally, unite so as to form a few trunks on the back of the penis, which divide near the root of the organ, and proceed to the glands of the groin. Those which originate from the interior parts of the penis, accompany the blood vessels, and terminate in the plexus of lymphatics in the pelvis.

It ought to be noted, that the superficial lymphatics *generally* enter the *upper* inguinal glands.

The *Nerves* of the penis are principally derived from the lower sacral nerves, which unite in the plexus that forms the great ischiatic. From these nerves a branch on each side originates, which passes, like the pudic artery, between the sacro-sciatic ligaments. In this course it divides into two branches, one

of which passes below to the muscles of the penis and urethra, and to the contiguous parts; and some of its branches seem finally to terminate in the dartos: the other branch proceeds along the crura of the pubis and ischium, and passing between the symphysis pubis and the body of the penis, arrives at the upper surface or dorsum of the penis, along which it continues on the outside of the veins to the glans, in which it terminates. In this course it sends off several branches, some of which terminate in the integuments of the penis.

After an examination of the relative situation of the muscles and blood vessels of the male organs of generation, there appears reason to doubt, whether the erection of the penis can be referred to pressure upon the veins which return from that organ. Albinus has written on this subject. See Academicarum Annotationum, lib. ii. caput xviii. Haller has also considered it, and stated the opinions of several anatomists, in his Elementa Physiologiæ, tom. vii. page 555.

The manner in which the urine is confined in the bladder does not appear to be clearly understood. The connexion of the neck of the bladder with the prostate, and the appearance of the contiguous parts of the bladder, do not render it probable that these parts act like a sphincter. The late J. Hunter, who paid great attention to the functions of these organs, was very decided in his opinion that the contraction of the urethra produced the effect of a sphincter of the bladder. He has published some very ingenious observations respecting the manner in which urine is discharged from the bladder, in his Treatise on the Venereal Disease, part iii. chapter ix.

Mr. Hunter also long since asserted, that the vascular convoluted appearance of the corpus spongiosum urethræ was more distinct in the horse than the man. In the fifth volume of the Leçons d'Anatomie Comparée of Cuvier, the very learned and ingenious author confirms the declaration of Hunter, respecting the vascular convolutions of the corpus spongiosum of the horse.

He states, that the corpora cavernosa of the penis of the elephant appear to be filled in a great degree with the ramifications of veins, which communicate with each other by such large and frequent anastomoses, that they have a cellular appearance. A similar structure exists in the horse, camel, bullock, deer, &c.; and in them all these communicating branches can be distinguished from those which extend the whole length of the penis.

The corpus spongiosum urethræ, according to M. Cuvier, is constructed in a similar manner. From these facts he is induced to believe that this structure pervades the whole class of mammalia.

CHAPTER VI.

OF THE FEMALE ORGANS OF GENERATION.

The female organs of generation consist of the *Uterus* and *Ovaries*, with their appendages; and of the *Vagina*, with the structure which surrounds its external orifice. The uterus is situated in the pelvis, between the bladder and rectum; and the ovaries are on each side of it. The vagina is a very large membranous canal, which passes from the uterus downwards and forwards, also between the bladder and rectum, and opens externally.

Connected with the orifice of the vagina are several bodies, which are called the *external parts of generation*, in order to distinguish them from the uterus and ovaries, and their appendages, and also from the canal of the vagina; which are called the *internal parts*.

The bladder of urine lies above and in contact with the vagina: the urethra is also intimately connected with it. The description of the bladder and urethra is therefore placed at the end of this chapter.

SECTION I.

Of the External Parts of Generation.

The adipose membrane, immediately anterior to the symphysis pubis, and on each side of it, forms a considerable prominence in females, which, at the age of puberty, is covered with hair, as in males. This prominence is denominated the *Mons Veneris*.

The exterior orifice commences immediately below this. On each side of this orifice is a promi-

nence continued from the mons veneris, which is largest above, and gradually diminishes as it descends. These prominences have some hair upon them. They are called the *Labia Externa.* Their junction below is denominated the *Fourchette.* The space between the place of their junction and the anus is rather more than an inch in extent, and is denominated the *Perineum.*

As the skin which forms the labia is continued internally, it becomes more thin and soft, and is covered by a more delicate cuticle. It is also more or less florid, and secretes a peculiar mucus.

In the upper angle, formed by the labia externa, is the upper extremity and glans of the clitoris.

The *Clitoris* is a body which has a very strong resemblance to the penis, but there is no urethra attached to it. It has two crura of considerable length, which originate, like those of the penis, from the crura of the pubis and ischium, and unite at the symphysis of the pubis so as to form a body, which is not much more than an inch in length, and is broad in proportion. The extremity of this organ, called the *Glans of the Clitoris,* forms a small tubercle, which is covered above and on the sides by a small plait or fold of the skin, denominated the *Prepuce.* These parts are lubricated by a secretion similar to that which is observed round the glans penis.

The crura of the clitoris have muscles similar to the erectores penis. The interior structure of the *Clitoris* is very similar to that of the corpora cavernosa of the penis, or the corpus spongiosum of the urethra. It appears constructed for a similar distention, and is endued with the same sensibility as the penis. The two lateral parts are also separated from each other by a septum, resembling that of the penis. It is united to the symphysis pubis by a ligament.

The *Prepuce* of the clitoris has a semicircular form: below its extremities two folds or plaits commence, one on each side, which are situated obliquely with respect to each other, so as to form an angle. These folds are denominated the *Nymphæ.*

The *Nymphæ* extend from the clitoris downwards nearly as far as the middle of the orifice of the vagina. They are situated within the external labia, and are formed by the skin after it has become more delicate in its texture. Their surface, however, is often somewhat corrugated. There are many blood vessels in their internal structure, and it is supposed they are occasionally somewhat tumid. They are flat, and their exterior edge is convex; so that they are narrow at their extremities, and broad in the middle. Their breadth is very variable, and in some instances is great. In a majority of cases, it is equal to one-fourth of their length. Their colour in young subjects is of a bright red; in women advanced in years, and who have had many children, they are of a brown red, and sometimes of a dark colour.

The use of these parts is not very evident. They have been supposed to regulate the course of the urine as it flows from the urethra, but their effect in this respect is not great. They have also been supposed to favour the necessary enlargement of the parts in parturition.

The orifice of the urethra is situated about an inch and one quarter farther inward than the clitoris. It is often rather less than the diameter of the urethra, and is somewhat protuberant. The orifices of mucous ducts are to be perceived around it.

The orifice of the urethra is at the commencement of the canal of the vagina. Immediately within this orifice is situated the membrane denominated *Hymen.*

The *Hymen* is an incomplete septum, made by a

fold or duplicature of the membrane which forms the surface contiguous to it. Sometimes it is circular, with an aperture in the centre. Sometimes it has a resemblance to the crescent, the aperture being at the upper part of it. The hymen has frequently been found without a perforation, and has therefore prevented the discharge of the menstrual evacuation. It is generally ruptured in the first intercourse of the sexes; and some small tubercles, which are found on the surface of the vagina near the spot where it was situated, are supposed to be the remains of it. These tubercles are called *Carunculæ Myrtiformes.*

SECTION II.

Of the Vagina.

The canal of the vagina, commencing at the hymen and the orifice of the urethra, is rather more narrow at its beginning than it is farther inward. From this place it extends backwards and upwards, and partakes in a small degree of the curve of the rectum: while the bladder, which is above it, and rests upon it, increases the curvature of the anterior part. It is much larger in women who have had children than in those who have not.

The membrane which lines the vagina resembles to a certain degree, the membranes which secrete mucus in different parts of the body. Its surface appears to consist of very small papillæ; and at the anterior extremity of the vagina it forms a great number of rugæ, which are arranged in a transverse direction, both on the part of the vagina connected to the bladder, and on that part which is connected to the rectum, while the lateral parts of the vagina are smooth. These

rugæ are most prominent in the middle; so that a raised line appears to pass through them at right angles. This line extends from without inwards. The rugæ on the part next to the bladder are the strongest.

This arrangement of the surface of the vagina does not extend beyond the external half of the canal: on the internal half part, or that nearest the uterus, the surface is smooth.

The rugæ are considerably diminished in women who have had children.

Throughout this surface are to be seen, in some cases with the naked eye, the orifices of mucous follicles or ducts, which occasionally discharge considerable quantities of mucus.

Exterior to the lining membrane of the vagina is a dense cellular structure, which has not yet been completely investigated: it is of a lightish colour, and has some resemblance to the texture of the body of the uterus. It is very vascular, and appears to be of a fibrous structure. It may be very much distended, and seems to have a contractile power.

At the anterior extremity of the vagina, on each side of it, there is superadded to this, a cellular, or vascular substance, from eight lines to an inch in breadth: which, when cut into, resembles the corpora cavernosa, or the corpus spongiosum of the penis. These bodies commence near the body of the clitoris, and extend downwards on each side of the vagina. They have been called *Plexus Reteformis*, and *Corpora Cavernosa Vaginæ*, and are supposed to be occasionally distended with blood, like the clitoris and penis.

These corpora cavernosa are covered by muscular fibres, which pass over them on each side from the sphincter ani to the body of the clitoris; to each of which organs they are attached. These fibres con-

stitute the sphincter vaginæ muscle, and contract the diameter of the vagina at the place where they are situated.

The transversus perinei muscles also exist in the female. They pass from the tuberosities of the ischia, and are inserted into a dense whitish substance in the perineum, to which the anterior extremity of the sphincter ani is likewise attached.

The vagina is in contact with the rectum behind; the bladder lies upon it and anterior to it. A small portion of peritoneum, to be reflected to the rectum, is continued from the uterus upon the posterior part of it. The lateral portions of it are invested with cellular substance. The anterior extremity of the uterus, which is called the Os Tincæ, projects into it from above.

SECTION III.

Of the Uterus, the Ovaries and their Appendages.

The *Uterus* has been compared to a pear with a long neck.—There is, of course, a considerable difference between the body and neck; the first being twice as broad as the last. Each of these parts is somewhat flattened.

In subjects of mature age, who have never been pregnant, the whole of the uterus is about two inches and a half in length, and more than one inch and a half in breadth at the broadest part of the body: it is also near an inch in thickness.

It is generally larger than this in women who have *lately* had children.

The uterus is situated in the pelvis between the bladder and rectum, and is enclosed in a duplicature or fold of the peritoneum, which forms a loose septum that extends from one side of the pelvis to the other, and divides it into an anterior and posterior cham-

ber. The posterior surface of this septum is opposed to the rectum, and the anterior to the bladder. The two portions of this septum which are between the uterus and the lateral parts of the pelvis, are called the *Broad Ligaments.*

On the posterior surface, the *Ovaries* are situated on each side of the uterus, being enclosed by a process of the ligament or septum. Above them, in the upper edge of the septum, are the *Fallopian Tubes,* which are ducts that commence at the upper part of the uterus on each side, and proceed in a lateral direction for some distance, when they form an angle and incline downwards to the ovaries. These ducts are enclosed between the two lamina of the septum for the greater part of their length.

The peritoneum which forms the septum, is reflected from it, posteriorly, to the rectum, and the posterior surface of the pelvis, and anteriorly, to the bladder. In its progress in each direction, it forms small plaits or folds; two of which extend from the uterus to the rectum posteriorly, and two more to the bladder anteriorly: these are called the *Anterior and Posterior Ligaments of the Uterus.*

The other ligaments, which proceed more immediately from the uterus, are called the *Round Ligaments.* These arise from each side of the uterus, at a small distance before and below the origins of the Fallopian tubes, and proceed in an oblique course to the abdominal rings. These ligaments are also invested by the peritoneum. They pass through the rings and soon terminate.

In the body of the uterus is a cavity, which approaches to the triangular form, and from which a canal proceeds through its neck. This cavity is so small that its sides are almost in contact, and the canal is in proportion; so that this organ is very thick in proportion to its bulk.

The substance of which the uterus consists is very firm and dense: it is of a whitish colour, with a slight tinge of red. There are many blood vessels, with nerves and absorbent vessels, in its texture. The nature and structure of this substance has not yet been precisely ascertained. It appears very different indeed from muscle; but the uterus occasionally contracts, with great force, during labour. It is not rendered thin by its enlargement during pregnancy, and the blood vessels in its texture are generally enlarged at that time.

Exteriorly, the uterus is covered by the peritoneum, as has already been mentioned. Internally it is lined with a delicate membrane that has some resemblance to those which secrete mucus, and is generally of a whitish colour, abounding with small orifices that can be seen with a magnifying glass. This membrane is so intimately connected to the substance of the uterus, that some anatomists have supposed it was merely the internal surface of that substance, but this opinion is now generally abandoned. It is supposed that the colour of this membrane is more florid about the period of menstruation.

The cavity of the uterus, as has been observed before, is triangular in form. When the organ is in its natural position, the upper side of this triangle is transverse with respect to the body, and the other sides pass downwards and inwards. In each of the upper angles are the orifices of the Fallopian tubes, which are of such size as to admit a hog's bristle.

The two lower lines of the triangle are slightly curved outwards at their upper extremities; so that the upper angles of the triangle project outwards and the orifices of the Fallopian tubes are nearer to the external surface than they otherwise would be.

The lower angle of the cavity of the uterus is oc-

cupied by the orifice of the canal, which passes through the neck of the organ; this orifice is from three to four lines in diameter. The canal is about an inch in length, and is rather wider in the middle than at either end. On the anterior and posterior portions of its surface are many small ridges which have an arborescent arrangement, one large ridge passing internally from the commencement of the canal, from which a number of other ridges go off in a transverse direction. These ridges extend nearly the whole length of the canal. In the grooves, between the ridges, are the orifices of many mucous ducts. There are also on the surface a number of transparent bodies of a round form, equal in bulk to a middle-sized grain of sand, the nature and use of which is unknown. They have been called *Ovula Nabothi*, after a physiologist who published some speculations respecting their use, about the commencement of the last century.

The canal of the neck of the uterus is very different from other ducts, for it seems to be a part of the cavity to which it leads, and when the cavity of the uterus becomes enlarged in the progress of pregnancy, this canal is gradually converted into a part of that cavity.

The lower extremity of the neck of the uterus is irregularly convex and tumid. The orifice of the canal in it is oval, and so situated that it divides the convex surface of the neck into two portions, which are called the *Lips*. The anterior or upper portion is thicker than the other.

This extremity of the uterus protrudes into the vagina, and is commonly called *Os Tincæ*. As the anterior portion or lip is larger and more tumid than the posterior, the vagina extends farther beyond the os tincæ on the posterior part than on the anterior.

The Fallopian Tubes

Are two canals, from four to five inches in length, which proceed between the lamina of the broad ligaments, from the upper angles of the uterus, in a transverse direction, to some distance from the uterus, when they form an angle, and take a direction downwards towards the ovaries.

They are formed, for a considerable part of their extent, by a substance which resembles that of which the uterus consists, and are lined by a membrane continued from the internal membrane of the uterus. Their extremities appear to be composed of membrane, which is rendered florid by the blood vessels in its texture. At the commencement, their diameters are extremely small; but they enlarge in their progress. This enlargement is gradual for the first half, and afterwards sudden; the enlarged part is more membranous than the small part, and has a bright red colour. The large extremity is loose in the cavity of the pelvis, and is not invested by the lamina of the broad ligaments. Near the termination the diameter is often contracted; after which the membrane which forms the tube expands into an open mouth, the margin of which consists of fringed processes: this margin is also oblique, as respects the axis of the tube; and the different fringed processes are not all of the same length; but the longest are in the middle, and the others regularly diminish on each side of them: these processes constitute the *Fimbriæ* of the Fallopian tubes.

The internal surface of the large extremities of these tubes is extremely vascular; and there are some longitudinal fibres of a red colour to be seen on it.

The Round Ligaments,

Which have already been mentioned, are cords of a fibrous structure, with many blood vessels in them. They arise from the uterus below the origin of the Fallopian tubes, and proceed under the anterior lamina of the broad ligaments to the abdominal rings through which they pass; and then the fibres and vessels are expanded upon the contiguous cellular substance.

The Ovaries

Are two bodies of a flattened oval form; one of which is situated on each side of the uterus on the posterior surface of the broad ligament, and invested completely by a process of the posterior lamen, which forms a coat, and also a ligament for it. The size of this organ varies in different subjects, but in a majority of those who are about the age of maturity, it is between ten and twelve lines in length. It is connected to the uterus by a small ligament, or bundle of fibres of the same structure with the round ligaments, which is not more than two lines in diameter, and is included between the lamina of the broad ligament.

The process of the broad ligament forms an external coat to the ovary; within this is the proper coat of the organ, which is a firm membrane. This membrane is so firmly connected to the substance of the ovary which it encloses, that it cannot be easily separated from it. The ovary is of a whitish colour and soft texture, and has many blood vessels. In virgins of mature age it contains from ten to twenty vesicles, formed of a delicate membrane, filled with a transparent coagulable fluid. Some of these vesicles are situated so near to the surface of the ovary, that they are prominent on its surface; others are near the centre. They are very different in size; the largest be-

ing between two and three lines in diameter, and others not more than one-third of that size.

In women who have had children, or in whom conception has taken place, some of these vesicles are removed, and in their place a cicatrix is found.

It has been ascertained, that during the sexual intercourse with males, one of these vesicles, which was protuberant on the surface, is often ruptured, and a cavity is found. A cicatrix is soon formed, where the membrane was ruptured; and in the place occupied by the vesicle there is a yellow substance denominated *Corpus Luteum.* This corpus luteum generally continues until the middle of pregnancy: it often remains during that state, and for some time after delivery, but it gradually vanishes. The cicatrization continues during life.

In many cases these cicatrices correspond with the number of conceptions which have taken place; but they often exceed the number of conceptions, and they have been found in cases where conception has not been known to have taken place.

In very old subjects, where conception has never taken place, the vesicles are either entirely removed, or small dense tubercles only remain in their place.

The Arteries

Of the uterus are derived from two very different sources; namely, from the spermatic and from the hypogastric arteries.

The spermatic arteries, instead of passing directly down to the abdominal ring, proceed between the lamina of the broad ligament, and send branches to the ovaries, which may sometimes be traced to the vesicles. They also send branches to the Fallopian tubes and to the uterus. Those which are on the opposite

sides of the uterus anastomose with each other, and also with the branches of the hypogastric arteries. There are also branches of these arteries in the round ligaments which accompany them to their termination outside of the abdominal ring.

The principal arteries of the uterus are those derived from the hypogastric, which sends to each side of it a considerable branch, called the *Uterine*. This vessel leaves the hypogastric very near the origin of the internal pudic, and proceeds to the cervix of the uterus: it passes between the lamina of the broad ligaments, and sends branches to the edge of the uterus, which penetrate its texture. The branches which are in the texture of the uterus are very small, indeed, in young subjects. In women who have had children, they are considerably larger; but during pregnancy they gradually enlarge with the growth of the uterus, and become very considerable. These arteries observe a *serpentine and peculiarly tortuous* course. Those on the opposite sides anastomose with each other.

The Veins

Of the uterus, like the arteries, form spermatic and uterine trunks. The spermatic vein is much larger than the artery. It ramifies as in males, and forms a very large plexus, which constitutes the corpus pampiniforme. Many of the veins which form this body, originate near the ovary: a considerable number also come from the Fallopian tubes and the uterus. The spermatic vein and its branches are greatly enlarged indeed during pregnancy; and it is said that they are enlarged the same way during the menstrual discharge.

The most important veins of the uterus are the branches of the *Uterine Veins*. They are extremely numerous, and form a plexus on the side of the ute-

rus; from which two or more uterine veins proceed in the course of the artery, and join the hypogastric. These veins also are greatly enlarged during pregnancy.

The Lymphatic Vessels

Of the uterus, and its appendages, are very numerous. In the unimpregnated state they are small; but during pregnancy they increase greatly. They proceed from the uterus in very different directions. Some that accompany the round ligaments go to the lymphatic glands of the groin. Others, which take the course of the uterine blood vessels, pass to glands in the pelvis, and a third set follows the spermatic arteries and veins to the glands of the loins.

The Nerves

Of the ovaries are derived from the renal plexus, and those of the uterus and vagina from the hypogastric plexus, or the lower portions of the sympathetic, and the third and fourth sacral nerves.

SECTION IV.

Of the Bladder and Urethra.

The situation of the *Bladder*, as respects the symphysis pubis, is nearly alike in both sexes; but that part of it which is immediately behind the insertion of the uterus is rather lower in males than in females. The bottom of the bladder rests upon the upper part of the vagina, a thin stratum of cellular substance only intervening: when that viscus is distended it forms a tumour which compresses the vagina.

The ureters are inserted, and the urethra commences in the same part of the bladder, in both sexes.

The length of the *Urethra* is between one and

two inches. When the body is in an erect position, it is nearly horizontal; but it is slightly curved, with its convexity downwards. It is immediately above the vagina, and it passes below the body of the clitoris. The external orifice is rather more than an inch within the glans or head of the clitoris. This orifice is somewhat prominent in the vagina.

In the internal or lining membrane of the urethra there are many orifices of mucous follicles, and also longitudinal wrinkles, as in the urethra of males. The diameter of the female urethra and its orifice in the bladder are greater than they are in the male. For this reason it has been supposed, that women are less liable to calculus of the bladder than men.*

The urethra is intimately connected with the external coat of the vagina, and between them there is a spongy cellular substance which makes the rough surface of the vagina prominent; so that the urethra has been supposed, although erroneously, to be invested with the prostate. It is capable of great artificial dilatation.

Of the Changes induced in the Uterus in the progress of Pregnancy.

The alteration which takes place in the size of the uterus during pregnancy is truly great. About the conclusion of that period, instead of the small body above described, which is almost solid, the uterus forms an immense sac, which extends from the termination of the vagina in the pelvis, into the epigastric region, and from one side of the abdomen to the other; preserving, however, an ovoid figure.

This change is so gradual at first, that the uterus does not extend beyond the cavity of the pelvis before

* It has, however, been asserted that they are also less liable to calculi in the kidneys.

the third month, although at the end of the seventh month it is very near the epigastric region.

For the first six months the body of the uterus appears principally concerned in the enlargement: after this the cervix begins to change, and is gradually altered so as to compose a portion of the sac, rather of less thickness than the rest of the uterus; the mouth being ultimately an aperture in a part which is much thinner than the other portions of the organ.

The change which takes place in the texture of some of the appendages of the uterus is very important.

The *Broad Ligaments*, which seem particularly calculated to favour the extension of the uterus, are necessarily altered by the change in the size of that organ, but not entirely done away. The portion of peritoneum of which they are formed must be very much enlarged with the growth of the uterus, as it continues to cover it. The *Round Ligaments* are much elongated; and they observe a more straight course to the abdominal ring. The *Fallopian Tubes* are enlarged; and instead of passing off laterally from the uterus, they now proceed downwards by the side of it. The *Ovaries* appear rather larger and more spongy: their relative situation is necessarily lower.

The *change in the Uterus itself* is particularly interesting. The great increase of its size is not attended with any considerable diminution of thickness in its substance; *nor are the arteries much less convoluted than before pregnancy*, as might have been expected. They are greatly enlarged in diameter, and the orifices of the exhalent vessels on the internal surface of the uterus are much more perceptible.

The veins are much more enlarged than the arteries, and in some places appear more than half an inch in diameter. They are not regularly cylindri-

cal, but rather flat. They anastomose so as to form an irregular net-work.

The uterus appears much more fibrous and muscular in the gravid than in the unimpregnated state. The contractile power of the gravid uterus is not only proved by the expulsion of its contents, but also by very vigorous contractions, which are occasionally observed by accoucheurs.

Although the general effects which result from the particular conditions of the uterus in pregnancy, menstruation, &c., evince that the influence of this organ upon the whole system is very great, yet it seems probable that the sexual peculiarities of females are especially dependent upon the ovaria.

This sentiment is confirmed by an account of a woman in whom the ovaria were deficient, which is published in the London Philosophical Transactions for 1805, by Mr. C. Pears. The subject lived to the age of twenty-nine years. She ceased to grow after the age of ten years, and therefore was not more than four feet six inches in height: her breadth across the hips was but nine inches, although the breadth of the shoulders was fourteen. Her breast and nipples never enlarged more than they are in the male subject. There was no hair on the pubes, nor were there any indications of puberty in mind or body. She never menstruated. At the age of twenty-nine she died of a complaint in the breast, attended with convulsions.—The uterus and os tincæ were found not increased beyond their usual size during infancy. The cavity of the uterus was of the common shape, but its coats were membranous. The Fallopian tubes were pervious. "*The Ovaria were so indistinct that they rather showed the rudiments which ought to have formed them, than any part of the natural structure.*"

Another case, which confirms the aforesaid sentiment, is related in one of the French periodical publications.

It has been long known that a race of savages near the Cape of Good Hope were distinguished from the generality of their species by a peculiarity about the pudendum. An account of this structure has been

given with some precision by Messrs. Peron and Lesueur, in a paper which was read to the National Institute of France. It is a flat or apron, four incehs in length, which is united to the external labia near their upper angle, and hangs down before the clitoris and the external orifice of the parts of generation. It is divided below into two lobes, which cover the orifice. It is formed by a soft distensible skin, free from hair, which is occasionally corrugated like the scrotum, and is rather more florid than the ordinary cutis.*

The Abdomen of the Fœtus.

The difference between the fœtus and the adult, in the cavity of the abdomen, is very conspicuous at the first view.

The *Liver* in the fœtus is so large that it occupies a very considerable part of the abdomen. Its left lobe, which is larger in proportion than the right, extends far into the left hypochondriac region.

The *Bladder of urine,* when filled, extends from the cavity of the pelvis a considerable distance towards the umbilicus: so that the greatest part of it is in the cavity of the abdomen. A ligament of a conical figure extends from the centre of the upper part of the bladder to the umbilicus, with an artery on each side of it, which is soon to be described. This ligament, which is in the situation of the urachus of the fœtus of quadrupeds, is hollow, and thus frequently forms a canal, which has a very small diameter, that communicates with the bladder by an aperture still smaller, and continues a short distance from the bladder towards the umbilicus. In a few rare instances, this canal has extended to the umbilicus, so that urine

* This paper has not yet been published by the Institute, but it is referred to by M. Cuvier in his Leçons d'Anatomie Comparée, vol. v. page 124.—Messrs. Peron and Lesueur were naturalists who accompanied captain Baudin in his voyage of discovery, the latter has been for some years resident in Philadelphia.

has been discharged through it, but the ligament is commonly solid there.

The *Stomach* appears to be more curved in the fœtus than in the adult.

The *Great Intestine* does not extend sufficiently far, beyond the insertion of the ileon, to form the cæcum completely.

The *Glandulæ Renales* are much larger in proportion in the fœtus than in the adult. The colour of the fluid they contain is more florid.

The *Kidneys* are lobulated.

The *Testicles* in the fœtus are found above the pelvis, in the lumbar region, behind the peritoneum, until two months before birth. Thus situated, their blood vessels and nerves proceed from sources which are near them; but the vas deferens, being connected to the vesiculæ seminales by one extremity, is necessarily in a very different situation from what it is in the adult: it proceeds from the testicle downwards to the neck of the bladder.—While each testicle is in this situation, it is connected with a substance or ligament, called *Gubernaculum,* of a conical or pyramidical form, attached to its lower end, and extends from it to the abdominal ring. This substance is vascular, and of a fibrous texture: its large extremity adheres to the testicle, its lower and small extremity passes through the abdominal ring, and appears to terminate in the cellular substance exterior to that opening, like the round ligament in females. The *Gubernaculum,* as well as the testicle, is behind the peritoneum; and the peritoneum adheres to each of them more firmly than it does to any of the surrounding parts. It seems that, by the contraction of the *Gubernaculum,* the testicle is moved down from its original situation to the abdominal ring, and through the abdominal ring into the scrotum. The peritoneum, which adheres firmly to the gubernacu-

lum and testicle, and is loosely connected to the other parts, yields to this operation; and when the testicle has arrived near the abdominal ring, a portion of the peritoneum is protruded a little way before it into the scrotum; forming a cavity like the finger of a glove. The testicle passes down behind this process of the peritoneum, and is covered by it as it was in the abdomen. Although it appears protruded into the cavity, it is exterior to it, and behind it; and the vessels, &c. which belong to the testicle are also exterior to it.

The cavity formed in the scrotum, by this process of the peritoneum, necessarily communicates with the cavity of the abdomen at its formation; but very soon after the testicle has descended into the scrotum, the upper part of this cavity is closed up, while the lower part of the process continues unchanged, and constitutes the *Tunica Vaginalis Testis*. In some instances the upper part of this process does not close up, and the communication with the cavity of the abdomen continues. The descent of the intestine into the cavity thus circumstanced, constitutes that species of hernia which is denominated *Congenital.**

The *most important* peculiarities in the abdomen of the fœtus are those connected with the circulation of the blood.

The internal iliac or hypogastric arteries are larger

* These interesting circumstances respecting the original situation of the testicle, and its descent into the scrotum, were discovered and elucidated by Haller, Hunter, Pott, Camper, and several other very respectable anatomists and surgeons. There is, however, a difference of opinion, between some of them, as to the time when the testicle leaves the abdomen. Haller thought the testicles were seldom in the scrotum at birth. Hunter and Camper found them so generally.

It has been suggested that there are some national peculiarities in this respect; that amongst the Hungarians, for example, the testicles often remain above the abdominal ring until near the age of puberty.

The student will find an interesting description of the situation of the testis, and its descent in the fœtus, in the "Observations on certain parts of the Animal Economy," by John Hunter.

than the external iliacs. Their main trunks are continued on each side of the bladder to its fundus, and proceed from it, with the ligament, to the umbilicus; when they pass out of the abdomen to go along the umbilical cord to the placenta. These arteries are now denominated the *Umbilical*, and are very considerable in size. After birth, as there is no circulation in them, they soon begin to change: the cavity of them is gradually obliterated, and they are converted into ligaments. They are exterior to the peritoneum, and contained in a duplicature of it.

A vein also called the *Umbilical*, which is much larger in diameter than both of the arteries, returns from the placenta along the cord, and enters the cavity of the abdomen at the umbilicus. It proceeds thence, exterior to the peritoneum, but in a duplicature of it called the *Falciform Ligament*, to the liver, and enters that viscus at the *great fissure;* along which it passes to the left branch of the sinus of the vena portarum, into which it opens and discharges the blood which flows through it from the placenta. It opens on the anterior side of the branch of the vena portarum, and from the posterior side of the branch, opposite to this opening, proceeds a duct or canal, which opens into the left hepatic vein near its junction with the vena cava. This communicating vessel is called the *Ductus*, or *Canalis Venosus;* to distinguish it from the duct which passes from the pulmonary artery to the aorta, and is called *Ductus*, or *Canalis Arteriosus*. This venous duct carries some of the blood of the umbilical vein directly to the vena cava; but it is much smaller than the umbilical vein, and of course a considerable quantity of the blood which passes through the umbilical vein must pass through the liver, by the vena portarum, before it can enter the cava.

In some fœtal subjects, if a probe of sufficient length

be introduced within the umbilical vein and pushed forwards, it will pass to the heart, without much difficulty or opposition, as if it proceeded along one continued tube, although it really passes from the umbilical vein across the branch of the vena portarum, and then through the ductus venosus, and through a portion of the left hepatic vein, into the inferior vena cava.

If the umbilical vein be injected with a composition, which will be firm when cool, it appears to terminate in a rounded end, which is situated in the transverse fissure of the liver: the sinus of the vena portarum, into which this vein enters, appears like two branches going off, one from each side of it, and the ductus venosus like a branch continuing in the direction of the main trunk of the umbilical vein.

The umbilical vein, in its progress through the fissure of the liver, before it arrives at the sinus of the vena portarum, sends off a considerable number of branches to each of the lobes of that organ, but more to the left than to the right lobe.

After birth, when blood ceases to flow through the umbilical vein, it is gradually converted into a ligament; and the venous duct is also converted into a ligament in the same manner. The vena portarum, which before appeared very small, when compared with the umbilical vein, now brings all the blood which fills its great sinus, and increases considerably in size.

It has been ascertained by anatomical investigation, that the umbilical arteries above mentioned, after ramifying minutely in the placenta, communicate with the minute branches of the umbilical vein; and it is probable that the whole blood carried to the placenta by these arteries, returns by the umbilical vein to the fœtus.

It is clearly proved by the effects of pressure on the umbilical cord, in cases of delivery by the feet, as

well as by other similar circumstances, that this circulation cannot be suspended for any length of time without destroying the life of the fœtus. From these circumstances, and from the florid colour which the blood acquires by circulating in the placenta, it seems probable that the object of the circulation through that organ is somewhat analogous to the object of the pulmonary circulation through the lungs of adults.*

* During the first four months of pregnancy a very small vesicle, which does not exceed the size of a pea, is found between the chorion and the amnios, near the insertion of the umbilical cord into the placenta. It is connected to the fœtus by an artery and a vein, which pass from the abdomen through the umbilicus, and proceeding along the cord to the placenta, continue from it to the vesicle. The artery arises from the mesenteric, and the vein is united to the mesenteric branch of the vena portarum. It is probable that these vessels commonly exist no longer than the vesicle, namely, about four months; but they have been seen by Haller and Chaussier at the termination of pregnancy. They are called *Omphalo Mesenteric* vessels. The vesicle is denominated the *Umbilical Vesicle.*

This inexplicable structure is delineated in Hunter's Anatomy of the Gravid Uterus, plate xxxiii. figures v. and vi.; in the Academical Annotations of Albinus, first book, plate i. figure xii.; and also in the Icones Embryonum Humanorum of Soemmering, figure ii.

SYSTEM OF ANATOMY.

PART IX.

OF THE BLOOD VESSELS.

The blood vessels are flexible tubes, of a peculiar texture, through which blood passes from the heart to the different parts of the body, and returns again from these parts to the heart. They are to be found, in varying proportions, in *almost every* part of the body, and seem to enter into its texture.

The tubes which carry blood *from* the heart, are more substantial and more elastic than those through which it returns to the heart. They are generally found empty after death; and, therefore, were called *Arteries* by the ancient anatomists, who supposed that they carried air, and not blood.

The tubes which return the blood to the heart are denominated *Veins*. They are less substantial and less elastic than arteries, and are generally full of blood in the dead subject.

There are two great arteries, from which all the other arterial vessels of the body are derived. They are very justly compared to the trunks of trees, and the smaller vessels to their branches. One of these great arteries, called the *Aorta*, carries blood to every part of the body. The other great vessel, called the *Pulmonary Artery*, carries blood exclusively to the lungs.

The veins which correspond to the branches of the *Aorta*, unite to each other, so as to form two great trunks that proceed to the heart. One of these trunks, coming from the superior parts of the body, is called the *Superior*, or *Descending Vena Cava*. The other, which comes from the lower parts of the body, is called the *Inferior*, or *Ascending Vena Cava*.

The veins which correspond with the branches of the *Pulmonary Artery*, and return to the heart the blood of the lungs, are four in number; two of them proceeding from each lung. They are called *Pulmonary Veins*.

In many of the veins there are valves which prevent the blood they contain from moving towards the surface and extremities of the body, but allow it to pass towards the heart without impediment.

From the construction of the cavities of the heart, and the position of the valves which are in them, as well as the situation of the valves at the commencement of the *great arteries*, and the above mentioned valves of the veins, it is evident, that when the blood circulates, it must move from the heart, through the aorta and its branches, to the different parts of the body, and return from these parts through the venæ cavæ, to the heart; that, when deposited in the heart by the venæ cavæ, it must proceed through the pulmonary artery to the lungs, and return from the lungs through the pulmonary veins to the heart, in order to pass again from that organ into the aorta.

It is also certain, that the blood is forced from the heart into the arteries, by the contraction of the muscular fibres of which the heart is composed; and that the blood vessels likewise perform a part in the circulation, they propelling the blood which is thus thrown into them: but their action appears to depend upon causes of a complex nature.

CHAPTER I.

OF THE GENERAL STRUCTURE AND ARRANGEMENT OF THE BLOOD VESSELS.

SECTION I.

Of the Arteries.

THE arteries are so much concerned in the important function of the circulation of the blood, that every circumstance connected with them is very interesting.

They are composed of coats or tunics, which are very elastic and strong, and which are also very thick. In consequence of the firmness of their coats, they continue open, after their contents are discharged, like hard tubes. They submit to great dilatation, and elongation, when fluids are forced into them, and return to their former dimensions when the distending cause is withdrawn. This elasticity is particularly subservient to the circulation of the blood. It admits the artery to distend readily, and receive the blood which is thrown into it by the contraction of the heart. It also produces the contraction of the artery; which takes place as soon as the action of the heart ceases; and this contraction of the heart necessarily forces the blood forward, as the valves at its orifice prevent it from returning to the heart.

The motion of the artery, which is so easily perceived by the touch, and in many instances also by the

eye, is completely explained by the discharge of blood into the artery from the heart, and by the elasticity of the vessel, by which it reacts upon the blood. In some cases it is not simply the diameter of the artery which is enlarged, but a portion of the vessel is elongated; and this elongation, by producing a curvature of it, renders its motion more visible.

In the aorta, and probably in its large branches, *Elasticity* seems to be the principal cause of the continuance of the motion which is originally given to the blood by the heart. But there are many circumstances connected with the smaller vessels, which evince that they exert a power which is very different indeed from elasticity. Thus, the application of local stimulants or rubefacients, and of heat, is followed by an increase of motion in the arteries of the parts to which they are applied. Neither of these causes could produce their effect by the influence of elasticity: but the effect of these and other similar causes is uniformly produced; and a power of independent motion, or *Irritability*, is thus proved to exist in these vessels, and seems essentially necessary to the circulation of the blood.

The Structure of the Arteries

Is, therefore, a subject of importance, and has received a considerable degree of attention from anatomists.

They are composed of a dense *elastic* substance, of a whitish colour. Their external surface is rough, and intimately connected with the cellular membrane, which every where surrounds it in varying quantities. Internally, they are lined with a thin membrane, which is very smooth and flexible, and is also very elastic. The substance which composes the artery, and is situated between the cellular investment and the internal

membrane, consists of fibres, which are nearly, though not completely circular, but so arranged as to constitute a cylinder. These fibres may be separated from each other so as to form lamina, which have been considered as different coats of the arteries; but there is no arrangement of them which composes regular distinct strata. The coats of arteries may, therefore, be separated into a greater or smaller number of lamina, according to the thickness of these lamina.

The fibres which compose these lamina appear to be united to each other in a way which readily allows of their separation, at the same time that they form a firm texture. Although arteries thus appear essentially different from muscles in their hardness and their elasticity, as well as in their general texture, they are considered, by a great majority of anatomists, as partaking more or less of a muscular structure.

In the human subject their structure is very difficult of demonstration, and great differences exist in the accounts which are given of it, even by anatomists who agree in the general sentiment that the arteries are muscular.

Thus, Haller believed that muscular fibres were most abundant in the large arteries, while J. Hunter thought the reverse.

Hunter appears to have investigated this subject with great attention, and supposed the muscular substance, in the composition of arteries, to be interior, and the elastic matter exterior; that in large arteries this muscular substance is very small in quantity, and gradually increases in proportion as the artery diminishes in size. He however observes, that he *never could discover the direction of the muscular fibres.**

When the great talents of Mr. Hunter as an anato-

* Treatise on the Blood, &c. vol. i. p. 118. Bradford's edition.

mist, are considered, this circumstance cannot fail to excite a belief that the existence of these fibres is not certain: and if to this be added the fact, that even the red coloured substance of the arteries is elastic, and in that respect different from muscular substance, the reasons for doubting must be increased.

Bichat appears to have entertained very strong doubts on the subject; but he stands almost alone; for a large number both of the preceding and contemporary anatomists, seem to have adopted the sentiment, that *the arteries have a muscular structure.*

The student of anatomy can very easily examine this subject himself, by separating the coats of arteries into different lamina; and by viewing the edges of the transverse and longitudinal sections of those vessels. While thus engaged with this question, he will read with great advantage what has been written upon it by Mr. Hunter, in his treatise on the blood, &c. See chapter second, section 3. Bichat ought also to be read upon this subject, which he has discussed in his *Anatomie Generale—Systeme Vasculaire a Sang Rouge,* article *Troisieme, &c.;* and also in his *Traite des Membranes,* article *Sixieme.*

The belief of the irritability of arteries does not, however, rest upon the appearance of their fibres.

1. It is asserted by very respectable authors,* that they have been made to contract by the application of mechanical and of chemical irritation, and also of the electric and galvanic power.

2. A partial or local action of arteries is often produced by the local application of heat and rubefacients, as has been already observed.

3. Arterial action is often suspended in a particular

* See Soemmering on the Structure of the Human Body, vol. iv. German edition. Dr. Jones on the Process employed by nature for suppressing Hemorrhage, &c.

part by the application of cold. It has also been observed that the arteries have for a short time ceased to pulsate in cases of extreme contusion and laceration of the limbs.*

4. When arteries are divided transversely in living animals, they often contract so as to close completely the orifice made by the division.

5. In a horse, bled to death, it was ascertained by Mr. Hunter, that the transverse diameter of the arteries was diminished to a degree that could not be explained by their elasticity. He also found that, after death the arteries, especially those of the smaller size, are generally in a state of contraction, which is greater than can be explained by their elasticity: for if they are distended mechanically, they do not contract again to their former size, but continue of a larger diameter than they were before the distention; although their elasticity may act so as to restore a very considerable degree of the contraction observed at death.

The contraction, which is thus done away by distention, Mr. Hunter supposed to have been produced by muscular fibres: for if it had been dependent on elasticity, it must have reappeared when the distending power was withdrawn.

It therefore seems certain, that the arteries have a power of contraction different from that which depends upon elasticity; but whether this depend upon muscular fibres superadded to them, or upon an irritable quality in the *ordinary elastic* fibres of blood vessels, is a question which is not perhaps completely decided.

The motion of the blood in the arteries appears to depend,

* This local suspension of arterial motion by cold, &c. applied locally, is very difficult to explain: as the action of the heart and the elasticity of the arteries appear sufficient to account for the pulsation of the large arteries.

1st, Upon the impulse given to it by the action of the heart.

2dly, Upon the elasticity of the arteries, in consequence of which they first give way to the blood impelled into them, and then react upon it; and

3dly, Upon the power of contraction in the arteries, or their irritability.

In the larger arteries the blood seems to move as it would through an inanimate elastic tube, in consequence of the impulse given by the heart, and kept up by the arteries themselves. In the smaller vessels it seems probable that the motion of the blood depends in a considerable degree upon the contraction which arises from their irritability.

The obvious effect of the elasticity of the arteries is to resist distention and elongation, and to contract the artery to its natural state, when the distending or elongating cause ceases to act. But it must also resist the contraction induced by the muscular fibres, and restore the artery to its natural size when the muscular fibres cease to act after contracting it, as has been observed by Mr. Hunter.

It seems probable that all the fibres of which the artery consists are nearly but not completely circular; for it is not certain that there are any longitudinal fibres in the structure of an artery.

The internal coat of these vessels is very smooth, but extremely dense and firm; and seems to be rendered moist and flexible by an exudation on its surface. It adheres very closely to the contiguous fibres of the coat exterior to it, but may be very readily peeled off from them. It is of a whitish colour, and, like the fibrous structure of the artery, is very elastic. Like that substance, also, it is easily torn or broken; and when ligatures have been applied to arteries, it has often been observed that the fibrous

structure, and the internal coat have been separated while this external cellular coat has remained entire.

The arteries are supplied with their proper blood vessels and lymphatics. It is to be observed, that the blood vessels are not derived from the artery on which they run, but from the contiguous vessels.

These vessels have nerves also, which are rather small in size, when compared with those which go to other parts.

Arteries appear to have a cylindrical form, for no diminution of diameter is observable in those portions of them which send off no ramifications.

When an artery ramifies the area of the different branches exceeds considerably that of the main trunk. Upon this principle, the aorta and its branches have been compared to a cone, the basis of which is formed by the branches, and the apex by the trunk.*

The transverse section of an artery is circular.

There are no valves in the arteries, except those of the orifices of the aorta and the pulmonary artery, at the heart. The valves of the pulmonary artery have been described in the 51st page of this volume, and those of the aorta have an exact resemblance to them, but are rather larger.

The course of the arteries throughout the body is obviously calculated to prevent their exposure to pressure, or to great extension from the flexure of the articulations by which they pass. With this view they sometimes proceed in a winding direction; and when they pass over parts which are subject to great distention or enlargement, as the cheeks, they often

* According to Brussiere the relation of the branches of the aorta to its trunk is as 25 to 16; Helvetius reckons the orifice of the aorta in comparison with its branches as 64 to 71. Lassus.—Ed.

meander; and, therefore, their length may be increased by straightening, without stretching them.

Their course appears sometimes to have been calculated to lessen the force of the blood, as is the case with the *Internal Carotid* and the *Vertebral* arteries.

In the trunk of the body the branches of arteries generally form obtuse angles with the trunks from which they proceed. In the limbs these angles are acute.

The communication of arteries with each other is termed *Anastomoses*. In some instances, two branches which proceed in a course nearly similar, unite with an acute angle, and form one common trunk.—Sometimes a transverse branch runs from one to the other, so as to form a right angle with each. In other cases, the two anastomosing branches form an arch, or portion of a circle, from which many branches go off.

By successive ramifications, arteries gradually diminish in size, until they are finally extremely small.

The small arteries do not carry red blood, their diameters being smaller than those of the red particles of that fluid, the serous or aqueous part of the blood can, therefore, only pass through them.

Many of the arteries which carry red blood, and of the last mentioned serous arteries, terminate in veins, which are in some respects, a continuation of the tube reflected backwards.*

* Malpighi and Leuwenhoek declare, that by the aid of a microscope they have seen arteries terminating in the veins. Haller advances formally his own experience in support of his assertion. Other anatomists have seen, that in blowing into an artery, the air passed into the corresponding veins. Nevertheless, Duverney and some others say, that a particular substance is interposed between the extremities of these vessels. Ruysch, in his Thesauras Anatomicus, VI. No. 73, says, in repletione arteriarum, replentur et plurimum quosque venæ, et vice versa, ita ut impossible videatur præcise dicere quomodo res se habeat. Discours sur l'Anat.—Ed.

They likewise terminate in exhalent vessels, which open upon the external surface, and upon the various internal surfaces of the body. The secretory vessels of glands are likewise the termination of many arteries.

SECTION II.

Of the Veins.

These tubes, which return to the heart the blood carried from it by the arteries, are more numerous than the arteries, and often are larger in diameter.

They generally accompany the arteries, and very often two veins are found with one artery.

In addition to these last mentioned veins, which may be called *deep-seated*, there are many subcutaneous veins which appear on almost every part of the surface of the body.

The capacity of all the veins is therefore much greater than that of all the arteries.

Those subcutaneous veins which are of considerable size, communicate very freely with each other, and also with the deep-seated veins.

The trunks of the veins, in those places where no branches go off, are generally cylindrical. There are, however, some exceptions, in which these vessels are irregularly dilated, as sometimes happens in the case of the internal jugular vein. It is, however, not easy to determine from the appearance of veins injected after death, respecting their situation during life, as their coats are very yielding; and it is very probable that they are, therefore, preternaturally dilated by the injection.

Veins, directly or indirectly, originate from the termination of arteries: but they do not pulsate as the arteries do, because the impulse given to the blood by

the heart is very much diminished in consequence of the great diminution of the size of the vessels through which the blood has passed.

In some cases, however, when blood flows from an opened vein, the extent of its projection is alternately increased and diminished, in quick succession, as if it were influenced by the pulsation of the heart.

The *Coats of Veins* differ considerably from those of *Arteries*,—for they are *thinner*, and so much less *firm*, that veins, unlike arteries, collapse when they are empty.

They consist of a dense elastic substance, the fibres of which are much less distinct than those of arteries, but some of them are to be seen in a longitudinal direction. *These fibres can be made to contract by local irritation;* for if a vein be laid bare in a living animal, and then punctured, it will often contract so as to diminish its diameter very considerably, although no blood shall have escaped from the punctures.

Next to the elastic substance is the internal coat, which is smooth and polished. It is separated from the substance exterior to it with difficulty, although it may be taken from it very easily in the vena cava.

This internal coat is more ostensible than the internal coat of arteries, and is not, like the latter, disposed to ossification. It is frequently so arranged as to form valves, which are plaits or folds, of a semilunar form, that project from the surfaces into the cavities of these vessels.*

Two of these valves are generally placed opposite to each other; and, when raised up, they form a sep-

* The valves of the veins were first described by Charles Etienne of Paris, in 1546. In 1547, Amatus, a Portuguese, saw at Ferrara, those at the mouth of the vena azygos. Sylvius, of Paris, announced them about the same time in the jugular, brachial and crural veins. Fabricus ab Aquapendente claims the discovery for himself in 1574. Lassus.—Ed.

tum in the cylindrical cavity of the vessel. The septum, thus composed, is concave towards the heart.

The valves have a great effect in preventing the contents of the veins from moving in a retrograde course: they therefore necessarily modify the effects of lateral pressure, in such a manner, that it propels the blood forward, or to the heart.

These valves are generally found in the veins of the muscular parts of the body, especially in those of the extremities. They are not found in those veins which are in the cavities of the body, nor in the internal jugulars. They are placed at unequal distances from each other.

The coats of the veins are somewhat transparent; and therefore those veins which are subcutaneous have a bluish aspect, which is derived from the colour of the blood they contain.

The colour of the blood in the veins is different from that in the arteries, being of a darker red.

The situation and arrangement of the large trunks of veins is much alike in different subjects; but the branches, especially those which are subcutaneous, are very variable in their situations.

CHAPTER II.

A PARTICULAR ACCOUNT OF THE DISTRIBUTION OF THE ARTERIES.

SECTION I.

*Of the AORTA,**

Or the Great Trunk of the Arterial System.

WHEN the heart is in its natural position, the right ventricle is nearly anterior to the left, and therefore, the AORTA, where it originates from the left ventricle, is behind the pulmonary artery, and covered by it. Its first direction is so oblique towards the right side of the body, that it crosses the pulmonary artery behind, and appears on the right side of it. It has scarcely assumed this position before its course alters, for it then proceeds obliquely backwards, and to the left; so as to form a large curve or arch, which extends to the left of the spine.

The position of this curve or arch is so oblique, with respect to the body, that the cord or diameter of it, if it were extended anteriorly and posteriorly, would strike the cartilage of the second or third *right* rib about the middle of its length, and the *left* rib near the head. In consequence of this position of the curve, the AORTA crosses over the right branch of the pulmonary artery, and the left branch of the windpipe: and assumes a situation, in front, and to the left of the third dorsal vertebra: from this situation it proceeds

* This name was given by Aristotle.—ED.

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downwards: in front, but rather on the left side of the spine, and in contact with that column.

The AORTA, as well as the *Pulmonary Artery*, for a small distance from the heart, is invested by the pericardium; and, when that sac is opened, appears to be contained in it.

After crossing the right branch of the *Pulmonary Artery*, a ligament is inserted into it, which proceeds from the main trunk of the pulmonary artery at its division: this ligament was the *Canalis Arteriosus* in the fœtus.

As the AORTA proceeds down the spine, it is situated between the two lamina of the mediastinum, and in contact with the left lamen, through which it may be seen. It descends between the crura of the diaphragm, in a vacuity which is sufficiently large to admit of its passage without pressure from the surrounding parts, and is still in contact with the anterior surface of the spine, but rather to the left of the middle of it. It continues this course along the spine until it arrives at the cartilaginous substance between the fourth and fifth lumbar vertebræ, when it divides into two great branches of equal size, which form an acute angle with each other. These are denominated the COMMON OR PRIMITIVE ILIAC Arteries.

From the AORTA in this course are sent off the arteries which are distributed to all the parts of the body for their nourishment and animation.

From the curve proceed the great branches which supply the heart, the head, the upper extremities, and part of the thorax. Between the curve and the great primitive iliac arteries, the *Aorta* sends off those branches which supply the viscera contained in the cavities of the thorax and abdomen,* and part

* It ought to be observed here, that the viscera, in the lower part of the pelvis, receive some branches from the internal iliac arteries.

of the trunk of the body. The great ILIAC branches of the AORTA are divided into smaller arteries, which supply the whole of the lower extremities and some of the viscera of the pelvis.

SECTION II.

Of the Branches which go off from the Arch of the AORTA.

THE proper arteries of the heart, denominated *Coronary Arteries,* proceed from the *Aorta* so near to the heart that their orifices are covered by the semilunar valves, when those valves are pressed against the sides of the artery. These arteries have been described in the account of the heart.—See p. 50.

The arteries of the head and of the upper extremities proceed from the upper part of the curve in the following manner.

A large trunk, called *Arteria Innominata,* goes off first. This is more than sixteen lines in length, when it divides into two branches, one of which supplies the right side of the head, and is denominated the *Right Carotid:* the other proceeds to the right arm, and from its course under the clavicle, is called, at first, the *Right Subclavian.* Almost in contact with the first trunk, another artery goes off, which proceeds to the left side of the head, and is called the *Left Carotid.* Very near to this, arises the third artery, which proceeds to the left arm, and is denominated the *Left Subclavian.* From these great branches originate the blood vessels, which are spent upon the head and neck and the upper extremities.

As these arteries arise from the curve of the *Aorta,* they are situated obliquely with respect to each other. The *Arteria Innominata is not only*

to the right, but it is also anterior to the two others: and the LEFT SUBCLAVIAN is posterior, as well as to the left of the LEFT CAROTID and the ARTERIA INNOMINATA.

THE CAROTID ARTERIES.

The two carotid arteries above mentioned have been denominated COMMON CAROTIDS, to distinguish them from their first ramifications, which are called INTERNAL and EXTERNAL CAROTIDS.

THE COMMON CAROTIDS

Proceed towards the head on each side of the trachea: at first they diverge, but they soon become nearly parallel to each other, and continue so until they have ascended as high as the upper edge of the thyroid cartilage, when they divide into the *Internal* and *External Carotids.*

These arteries are at first very near each other, and rather in front of the trachea; they gradually diverge and pass backwards and outwards on the sides of it, and of the œsophagus, until they have arrived at the larynx. In the lower part of the neck they are covered by the sterno mastoidei, the sterno hyoidei, and thyroidei, as well as by the platysma myoidei muscles. Above, their situation is more superficial; and they are immediately under the platysma myoides.

On the inside, they are very near the trachea and larynx, and the œsophagus; on the outside, and rather anterior to them, are the internal jugular veins; and behind, on each side, are two important nerves called the *intercostal* and the *par vagum.* These blood vessels and nerves are surrounded by absorbent vessels.

The *Common Carotid Arteries* send off no branches from their origin to their bifurcation; and they appear to preserve the same diameter throughout their whole extent. In some few instances the right carotid has been found larger than the left. The external and internal branches into which they divide, are nearly equal in the adult; but it is supposed that the internal is the largest during infancy. The relative position of these branches is also different at the commencement from what it is afterwards. The *Internal Carotid* forms a curve which projects outwardly, so as to be exterior to the *External Carotid*, while this last proceeds upwards, and rather backwards.

THE EXTERNAL CAROTID ARTERY

May be considered as extending from its commencement, which is on a line with the superior margin of the thyroid cartilage, to the neck of the condyle of the lower jaw, or near it.

At first it is superficial; but as it proceeds upwards it becomes deep-seated: and passing under the digastric and stylo-hyoidei muscles, and the ninth pair of nerves, is covered by the *Parotid Gland*. After this, it again becomes superficial; for the temporal artery, which may be regarded as the continuation of the external carotid, passes over the zygomatic process of the temporal bone.

As the *external carotid* supplies with blood the upper part of the neck and throat, the exterior of the head and face, and the inside of the mouth and nose; its branches must necessarily be numerous, and must pass in very various directions.

Thus, soon after its commencement, it sends off, in an anterior direction, three large branches; viz. to the upper part of the neck, to the parts within the lower jaw, and to the cheeks and lips. These are deno-

minated, the *Superior Thyroid*, the *Sublingual*, and the *Facial*. It then sends off to the back of the head one which is called the *Occipital;* and, as it proceeds upwards near the condyle of the lower jaw, another which passes internally, behind the jaw, to the deep-seated parts in that direction. After this, it forms the temporal artery, which supplies the forehead and central parts of the cranium. Besides these larger branches, the external carotid sends off two which are smaller; one from near the origin of the sublingual artery, which is spent principally upon the pharynx and fauces, and is called the *Inferior Pharyngeal:* and another, while it is involved with the parotid gland, which goes to the ear; and is therefore called *Posterior Auris*.

These arteries are distributed in the following manner:

1. The superior thyroid branch

Comes off very near the root of the external carotid, and sometimes from the common trunk; it runs obliquely downwards and forwards, in a meandering course, to the thyroid gland, where it is spent. During this course it sends off one branch to the parts contiguous to the os hyoides; another to the neighbourhood of the larynx: and a third branch, which may be termed *laryngeal,* that passes with a small nerve derived from the laryngeal branch of the par vagum, either between the os hyoides and thyroid cartilage, or the thyroid and cricoid cartilages, to the interior muscles of the larynx; and finally returns again to terminate externally.

While in the thyroid gland this artery anastomoses with the inferior thyroid, and also with its fellow on the opposite side.

2. The lingual, or sublingual branch,

Goes off above the last mentioned artery, and very near it; but in a very different direction, for it runs upwards and forwards, to the tongue. In this course it crosses obliquely the os hyoides, and is commonly within the hyoglossus muscle. It gives off branches to the middle constrictors of the pharynx, and to the muscles contiguous to the tongue. It also sends off a branch which penetrates to the back of the tongue, which is called, from its situation, *Dorsalis Linguæ*. At the anterior margin of the hyoglossus muscle it divides into two branches, one of which passes to the sublingual gland and the adjacent parts, and is thence called *Sublingual;* while the other branch, the *Ranina,* passes by the side of the genio glossus muscle to the apex of the tongue.

3. The facial or external maxillary,

Runs obliquely upwards and forwards under the ninth pair of nerves, the stylo hyoideus muscle and the tendon of the digastric, across the lower jaw and cheek, towards the inner corner of the eye, in a serpentine course. Before it crosses the jaw it sends off several branches, viz. to the pharynx, the tonsils, the inferior maxillary gland and the parts contiguous to it. It also sends a branch towards the chin, which passes between the mylo-hyoideus, the anterior belly of the digastric, and the margin of the lower jaw: and some of its branches continue to the muscles of the under lip. This branch is called the *Submental.*

This artery then passes round the basis or inferior edge of the lower jaw, very near the anterior margin of the masseter muscle, and is so superficial that its pulsations can be readily perceived. After this turn, its course is obliquely upwards and forwards. Near

the basis of the jaw it sends off a branch to the masseter, which anastamoses with small branches from the temporal; and another which passes superficially to the under lip and contiguous parts of the cheeks. This last is called the *Inferior Labial.*

After the artery has passed as high as the teeth in the lower jaw, it divides into two branches; which go, one to the under, and the other to the upper lip; that to the upper lip is largest. These branches are called *Coronary.*

The *Coronary Artery of the lower lip* passes under the muscles called *Depressor Anguli Oris,* and *Orbicularis Oris,* into the substance of the lip, and anastomoses with its fellow of the opposite side.

The *Coronary Artery of the upper lip* passes under the zygomaticus major and the orbicularis, and very near the margin of the upper lip internally. It also anastomoses freely with its fellow on the opposite side. These anastomoses are frequently so considerable that the arteries on one side can be well filled by injecting those of the other. The coronary branches, as well as the main trunk of the facial artery, observe a serpentine or tortuous course; in consequence of which they admit of the motions of the cheeks and lips, which they would greatly impede, if they were straight.

From the upper coronary artery a branch continues in the direction of the main trunk of the facial artery, by the side of the nose, which extends upwards, sending off small branches in its course, and finally terminates about the internal angle of the eye and the forehead.

4. The inferior pharyngeal

Is a very small artery; it rises posteriorly from the external carotid, opposite to the origin of the sublingual, and passes upwards to the basis of the cranium.

In this course it sends several branches to the pharynx, and to the deep-seated parts immediately contiguous.

It also sends branches to the first ganglion of the intercostal nerve, to the par vagum, and to the lymphatic glands of the neck; and, finally, it enters the cavity of the cranium by the posterior foramen lacerum.

In some cases it also sends a small branch through the anterior foramen lacerum.

5. The occipital artery

Arises from the posterior side of the external carotid, nearly opposite to the facial, but sometimes higher up; it ascends obliquely, and passes to the back part of the cranium, between the transverse process of the atlas and the mastoid process of the temporal bone.

In this course it passes over the internal jugular vein and the eighth pair of nerves, and under the posterior part of the digastric muscle; it lies very near to the base of the mastoid process, *and under the muscles which are inserted into it.* After emerging from these muscles, it runs superficially upon the occiput, dividing into branches which extend to those of the temporal artery.

The occipital artery sends off branches to the muscles which are contiguous to it, and to the glands of the neck.

It also gives off the following branches; one called the *Meningeal,* which passes through the posterior foramen lacerum to the under and back part of the dura mater: one to the exterior parts of the ear: another which passes downwards, and is spent upon the complexus trachelo mastoideus, and other muscles of the neck: and several smaller arteries.

The artery next to be described, is sometimes sent off by the occipital artery.

6. The POSTERIOR AURICULAR, OR STYLO MASTOID ARTERY.

When it arises from the external carotid, comes off posteriorly from the artery, where it is involved with the parotid gland, and passes backwards between the meatus auditorius externus and the mastoid process. It then ascends, in a curved direction, and terminates behind the ear.

In this course it sends off small branches to the parotid gland, and to the digastric and sterno mastoid muscles. Sometimes a distinct branch, which is particularly visible in children, passes through an aperture in the meatus auditorius externus, and is spent on its internal surface.

It also sends off a branch which enters into the *Stylo Mastoid Foramen*, and supplies small vessels to the membrana tympani and the lining membrane of the cavity of the tympanum; to the mastoid cells; to the muscle of the stapes, and to the external semicircular canal. One of these vessels anastomoses, in the upper and posterior part of the cavity of the tympanum, with a small twig derived from the artery of the dura mater. When it has arrived behind the ear, the *Posterior Auricular Artery* terminates upon the external ear and the parts contiguous to it.

7. The INTERNAL MAXILLARY ARTERY*

Arises from the external carotid under the parotid gland, at a little distance below the neck of the con-

* The general situation of this artery, and the distribution of several of its most important branches, cannot be understood without a knowledge of the bones through which they pass. The student of surgery will therefore derive benefit from a re-examination of these bones, and

dyloid process of the lower jaw, and extends to the bottom of the zygomatic fossa varying, its direction in its course. It is rather larger than the temporal.

A. It first sends off one or two small branches to *the ear*, and a twig which penetrates into the cavity of the tympanum by the glenoid fissure.

B. It also sends off a small artery called the *Lesser Meningeal*, which passes upwards, and, after giving branches to the external pterygoid and the muscles of the palate, passes through the foramen ovale, and is spent upon the dura mater about the sella turcica.

C. It then sends off one of its largest branches, the *Great or middle Artery of the Dura Mater*, which passes in a straight direction to the foramen spinale, by which it enters into the cavity of the cranium.

This artery ramifies largely on the dura mater, and makes those arborescent impressions which are so visible in the parietal bone. It generally divides into two great branches: the anterior of which is the largest, passes over the anterior and inferior angle of the parietal bone: the posterior branch soon divides into many ramifications, which are extended laterally and posteriorly.

It furnishes the twig which passes to the ear by the hyatus of Fallopius, and anastomoses with the small branches of the stylo mastoid artery.

It also supplies some other small vessels which pass to the cavity of the tympanum by small foramina near the junction of the squamous and petrous portions of the temporal bone.

D. The next branch sent off by the internal maxillary leaves it about an inch from its origin, and is

of the zygomatic fossa, &c. when he studies this artery. (See Vol. I. page 73.)—He ought to be well acquainted with this subject, if he should undertake the management of necrosis of the jaw bones; or of those fungous tumours, which sometimes originate in the antrum maxillare; as well as of several other complaints.

called the *Inferior Maxillary.* It passes between the internal pterygoid muscle and the bone, and after giving small branches to the contiguous muscles, enters the canal in the lower jaw, in company with the nerve. This canal has a very free communication with the cellular structure of the jaw, and the artery in its progress along it sends branches to the respective teeth and the bone. At the anterior maxillary foramen this artery sends off a considerable branch which passes out and anastomoses with the vessels on the chin, while another branch passes forward and supplies the canine and incisor teeth and the bone contiguous to them.

Sometimes the inferior maxillary artery divides into two branches before it has arrived at this foramen. In this case, one of the arteries passes out of the foramen, while the other continues to the symphysis.

E. Two branches pass off to the temporal muscle, which originate at a small distance from each other; one of them passes upwards on the tendon of the temporal muscle; the other arises near the tuberosity of the upper maxillary bone: they are called the *exterior deep, and the interior deep, temporal artery.* They are both spent upon the temporal muscle; but the interior branch sends a small twig into the orbit of the eye.

F. There are some small branches which pass to the *Pterygoid Muscles* and to the *Masseter,* which arise either from the internal maxillary artery, or from the interior deep temporal. They are generally small, and often irregular.

G. An artery, particularly appropriated to the cheek, perforates the buccinator muscle from within outwards, and generally terminates on the buccinator, the zygomaticus major, and the muscles of the lips. This *Artery of the Cheek* is very irregular in its

origin, sometimes arising from the internal maxillary, sometimes from the deep temporal, and sometimes from the suborbitary, or from the alveolar artery, to be immediately described.

H. The *Alveolar Artery* or the *Artery of the Upper Jaw*, arises generally from the internal maxillary, but sometimes from one of its branches. It winds round the tuberosity of the upper jaw, and sends branches to the buccinator muscle, to the bone and the gums, to the antrum Highmorianum, and some of the molar teeth : and also to the teeth generally, by means of a canal which is analogous to that of the lower jaw.

I. The *Infra orbitar Artery* arises from the internal maxillary in the zygomatic fossa, and soon enters the infra orbitary canal, through which it passes to the face, and emerges below the orbit of the eye, supplying the muscles in the vicinity, and anastomosing with the small ramifications of the two last described arteries, and also of the facial artery and the ophthalmic.

This artery in its course sends off small twigs to the periosteum, the adipose membrane, and the muscles in the inferior part of the orbit, and also to the great maxillary sinus or antrum Highmorianum, and to the canine and incisor teeth.

J. The *Palato Maxillary* or *Superior Palatine Artery*, arises also in the zygomatic fossa, and, descending behind the upper maxillary bone, enters the posterior palatine canal. It generally forms two branches, the largest of which advances forward, supplying the palate and gums, and finally sends a twig through the foramen incisivum to the nose, while the posterior branch, which is much smaller, supplies the velum pendulum palati.

K. The *Peterygo Palatine*, or *Superior Pharyngeal*, is a small vessel, which sometimes arises from the

artery next to be mentioned. It is spent upon the upper part of the pharynx, and a branch passes through the pterygo palatine foramen, which is spent upon the arch of the palate and the contiguous parts.

L. The INTERNAL MAXILLARY at length terminates in the *Spheno-Palatine*, or *Large Nasal Artery*, which passes through the spheno-palatine foramen to the back part of the nose. This artery sometimes separates into two branches before it enters the foramen; sometimes it enters singly, and divides into two branches soon after; one of them is spread upon the septum, and the other upon the external side of the nose; each of these branches ramifies very minutely upon the Schneiderian membrane and its processes in the different sinuses, and also in the ethmoidal cells.

8. THE TEMPORAL ARTERY

Is considered as the continuation of the external carotid, because it preserves the direction of the main trunk; although the internal maxillary is larger.

After parting with the internal maxillary it projects outwards; and passing between the Meatus Auditorus Externus and the condyle of the lower jaw, continues upwards, behind the root of the zygomatic process of the temporal bone, to the aponeurosis of the temporal muscle : on the outside of which, immediately under the integuments, it divides into two large branches denominated *anterior* and *posterior*.

Before this division the temporal artery sends off several branches of very different sizes.

One, which is considerable in size, and called the *Transverse Facial Branch*, advances forwards across the neck of the condyle of the lower jaw, and giving small branches to the masseter, runs parallel to the parotid duct, and below it. This branch is spent upon

the muscles of the face, and anatomoses with the other vessels of that part.

The temporal gives off small branches to the parotid gland and to the articulation of the jaw. From the last mentioned branch small twigs pass to the ear, one of which enters the cavity of the tympanum by the glenoid fissure.

While this artery is on a line with the zygoma, it sends off a branch called the *middle temporal artery*, which penetrates the aponeurosis of the temporal muscle, and ramifies under it upon the muscle in an anterior direction.

The two great branches of the temporal artery are distributed in the following manner. The *Anterior* passes up in a serpentine direction on the anterior part of the temple, and supplies the front side of the head and the upper part of the forehead.

The *Posterior* extends upwards and backwards, and supplies the scalp on the lateral and middle part of the cranium, and also the bone.

Ramifications from each of these branches anastomose on the upper part of the cranium with those of its fellow of the opposite side. The anterior branch also anastomoses on the forehead with the facial and ophthalmic artery; and the posterior branch with the occipital artery on the back part of the head.

THE INTERNAL CAROTID ARTERY

Is sometimes called the *Artery of the Brain*, as it is almost entirely appropriated to that viscus.

From its origin to the commencement of its ramifications, the course of this blood vessel is peculiarly tortuous. In consequence of which the force of the blood in it is greatly diminished before it arrives at the brain.

An instance of this curvature occurs immediately

after its separation from the external carotid, when it protrudes outwards so much as to be exterior to that vessel; after this it ascends to the carotid canal, and in its course is in contact, or very near the par vagum and intercostal nerves.

The carotid canal in the os petrosum is by no means straight; it forms a semicircular curve, forwards and inwards; and its upper portion, which is nearly horizontal, opens obliquely against the body of the sphenoidal bone, at a small distance from it. Therefore, after the artery has passed through the canal, it must turn upwards to get fairly into the cavity of the cranium; and, of course, its direction while in the canal, forms almost a right angle with its direction before it enters, and after it emerges from it.

In consequence of this curvature, much of the momentum of the blood must be impressed upon the cranium.

After the artery has arrived at the end of the carotid canal, and has turned upwards to get within the cavity of the cranium, it bends forwards, and passes nearly in a horizontal direction, through the cavernous sinus on the side of the sella turcica, to the anterior clinoid process; here it again forms a considerable curve, which is directly upwards, and then it perforates the dura mater.

These curvatures must also deprive the blood of the carotid of a portion of the momentum which it has retained after leaving the bone.

The object of these various flexures of the internal carotid appears to be analogous to that of the *Rete Mirabile* in certain quadrupeds, which is formed by the division of this artery into many small branches, that reunite again, without producing any other effect than the diminution of the momentum of the blood.

During its course from the place of bifurcation to its entrance into the carotid canal, the internal carotid artery very rarely sends off any branches. In the canal it gives off a *small twig* which enters the *cavity of the tympanum;* and sometimes a *second,* which unites with the *Pterygoid branch* of the internal maxillary.

As it goes by the sella turcica, it passes through the cavernous sinuses, and gives off two branches, which are called the *Posterior and Anterior Arteries of the Cavernous Sinus or Receptacle.*

The posterior branch goes to that part of the dura mater which is connected with the posterior clinoid process, and the cuneiform process of the occipital bone. It likewise gives branches to several of the nerves which are contiguous, and to the pituitary gland.

The anterior artery also gives branches to the contiguous nerves, to the dura mater, and the pituitary gland.

When the internal carotid turns upwards at the anterior clinoid process, it sends off the

OPHTHALMIC ARTERY,

Which passes under the optic nerve through the foramen opticum into the orbit of the eye, and is about a line and a half in diameter.

Although this artery enters the orbit under the optic nerve, it soon takes a position on the outside of it, but afterwards gradually proceeds to the inner side of the orbit, crossing *over* this nerve in an oblique direction, and finally passes out of the orbit near the internal angle. In this spiral course it sends off numerous branches, viz.

A. To those parts which are auxiliary to the eye.

B. To the ball of the eye.

C. To the cavity of the nose, through small foramina in the ethmoid bone, and

D. To the forehead and external side of the nose.

These branches generally go off in the following order.

1. The *Lachrymal Artery* arises soon after the ophthalmic arrives within the orbit, and passes above the abductor muscle to the lachrymal gland, where it terminates, sending off many small branches in its course.

2. The *Central Artery* of the retina also leaves the ophthalmic soon after its arrival in the orbit: it is a small vessel which penetrates into the centre of the optic nerve, and, passing with it into the eye, is spread upon the internal surface of the retina. Here it appears to terminate in the adult; but in the fœtus it is continued through the vitreous humour to the capsule of the crystalline lens.

3. While the ophthalmic is passing over the optic nerve the branches which enter the ball of the eye leave it. Their number varies, but they form three classes, viz. The *Long Ciliary*, the *Short Ciliary*. and the *Anterior Ciliary arteries*. (See description of the eye, vol. i. p. 360,) the supra orbitary and muscular branches leave it also near the same places.

4. The *Supra Orbitary Branch* often gives off several muscular twigs: but it passes out of the orbit through the supra orbitar foramen, and generally divides into two branches, one of which is spent upon the periosteum, and the other upon the skin and muscles of the forehead.

5. There are sometimes *two muscular branches, a Superior and an Inferior.* The superior branch is often deficient: when it exists it supplies the levator palpebræ, the levator oculi, obliquus superior, &c.; but these parts are often supplied by the branches

above mentioned. The supra orbitar so frequently gives off branches to the muscles, that it has been called the *Superior Muscular Branch.* The inferior muscular branch is more constant. It commonly supplies the rectus inferior, the adductor, and the inferior oblique muscles, and also the lachrymal sac, and the lower eyelid, &c.

When the artery is on the inside of the nerve it sends off the two branches to the cavity of the nose, viz. *The Ethmoidal Arteries;* and, also, branches to the eyelids.

6. The *Posterior Ethmoidal* branch is first. It passes between the levator and abductor muscles, and above the obliquus superior, and penetrates the cavity of the cranium by the posterior orbitary foramen: after giving some twigs to the dura mater, it passes to the posterior cells of the ethmoid by the foramina of the cribriform plate of that bone, and sends a small branch to the Schneiderian membrane on the back part of the septum of the nose.

7. The *Anterior Ethmoidal* artery arises from the ophthalmic nearly opposite to the anterior orbitary foramen, through which it passes: and after entering the cranium is distributed like the other through some of a foramina of the cribriform plate to the anterior cells of the ethmoid bone, and to the anterior part of the Schneiderian membrane on the septum of the nose, to which it sends a considerable branch.

In its course it sends twigs to the frontal sinuses, and to the dura mater and its falciform process.

8. The *arteries of the Palpebræ* are called *Superior* and *Inferior;* they leave the ophthalmic near the loop or pulley of the superior oblique muscle. The inferior comes off first; it sends branches to the ligaments of the tarsus, the caruncula lachrymalis, and the parts connected with the cartilage of the un-

der eyelid, and unites with the lachrymal artery near the external canthus, forming an arch called the *Inferior Tarsal Arch.*

9. The *Superior Artery* supplies the superior part of the orbicularis muscles, the ligament and caruncula also: and it likewise unites with a twig of the lachrymal, and forms the superior tarsal arch.

Soon after sending off the palpebral branches, the *Ophthalmic Artery* arrives at the internal canthus, and then finally divides into two branches, the *nasal* and the *frontal.*

10. The *Nasal Branch* passes above the superior part of the lachrymal sac, and the ligament of the eyelid to the nose; after sending a twig to the frontal muscle and the lachrymal sac, it passes down the side of the nose and anastomoses with the facial artery.

11. The *Frontal Artery* is not so large as the nasal; it generally divides into three parts. A superciliary branch, which is principally spent upon the eye-brows; a superficial branch, which is spent upon the forehead; and a branch which is distributed to the pericranium.

The INTERNAL CAROTID, soon after parting with the ophthalmic, sends off, in a posterior direction, a branch to join one from the vertebral artery. From its destination, this vessel is called the *arteria communicans.*

After this it sends off another branch, which is so large that it may be considered as a continuation of the main trunk: this is called the *middle artery of the brain,* or the *Arteria Sylviana.* It runs outwards nearly in the direction of the fossa Sylvii, which separates the anterior from the middle lobes of the cerebrum. In its course it divides and subdivides into numerous branches, which are spread upon the *Pia Mater,* and finally enter the surface of the brain in a very minute state.

The internal carotid then terminates in a branch,

which is smaller than the last mentioned, and from its situation is called the *Anterior Artery of the Brain,* or *Arteria Callosa.* This vessel first inclines towards its fellow on the opposite side, and after approaching within half an inch of it, forms another curve, and runs forward to the anterior part of the brain, dividing itself gradually into two branches, which pass in several directions.

When these anterior arteries are nearest to each other, a small *transverse* branch, which passes at right angles, connects them together. This branch completes the anterior part of the *Circle of Willes.*

It crosses immediately before the sella turcica and pituitary gland, and sends off branches which pass to the third ventricle, to the fornix and septum lucidum, and also to the pia mater.

The *Anterior Arteries* of the brain also send off branches to the optic and olfactory nerves; to the opposite surfaces of the two hemispheres on each side of the falx, to their inferior surfaces, and to the corpus callosum.

They have likewise some branches which anastomose with those of the middle artery of the brain, and of the vertebral artery.

The SUBCLAVIAN *Arteries.*

The RIGHT SUBCLAVIAN may be considered as the continuation of the arteria innominata. This last mentioned artery, after leaving the aorta, forms a curve or arch, which extends obliquely backwards and outwards, over the first rib to the axilla, crossing the trachea in its course. At the distance of an inch and a quarter, or an inch and a half from its origin, it sends off the right carotid, and then, assuming the name of *Right Subclavian,* continues in the above stated direction.

The chord of the curve of this artery, and the chord of the curve of the aorta, are not in the same direction, but form an angle with each other.

The position of the LEFT SUBCLAVIAN is somewhat different from that of the right. Its origin is posterior, and, therefore, the direction of the chord of its curve is more immediately lateral. The curve or arch is also smaller. The situation of the two subclavians as relative to the contiguous parts, is, therefore, somewhat different; but each of them proceeds between the anterior and the middle scaleni muscles, and when they have arrived at these muscles, their respective positions are very similar.

The anterior and middle scaleni muscles arise from the transverse processes of several of the cervical vertebræ, and are inserted into the first rib, one before the other, so as to leave a considerable space between them. The subclavian arteries pass through this space, and before they arrive at it, but when they are very near the above mentioned muscles, they send off several very important branches in various directions, viz. to the cavity of the cranium, to the parietes of the thorax, to the thyroid gland, and to the lower part of the neck.

They proceed near to the scaleni muscles before they send off any branches; and it is to be observed, that the subclavian veins which correspond with these arteries, are anterior to them, for they pass before the scaleni muscles, and not between them.

The INTERNAL MAMMARY *Artery*

Goes downwards, from the lower and anterior part of the subclavian, along the inner side of the anterior scalenus muscle. It proceeds, exterior, to the pleura, across the cartilages of the true ribs, and near their middle; and, continuing between the cartilages and the diaphragm, exterior to the perito-

neum, terminates on the rectus abdominis muscle, in branches which anastomose with those of the epigastric artery. In this course, it gives branches to almost all the parts to which it is contiguous, viz. to the muscles and glands at the lower part of the neck; to the thymus gland; to the parts in the intercostal spaces; to the sternum; to the mediastinum and pericardium; to the diaphragm and to the muscles of the abdomen.

From some of its ramifications upon the parts between the ribs, small branches go off to the mamma, and thereby give a name to the artery. There is also a small vessel which is sent off by the mammary artery, or by one of its upper branches which accompanies the phrenic nerve to the diaphragm.

The INFERIOR THYROID *Artery*

Arises from the upper side of the subclavian nearly opposite to the origin of the internal mammary. It passes upwards and inwards, between the carotid artery and the spine, to the thyroid gland: then it anastomoses with the branches of the superior thyroid on the same side, and with those of its fellow on the opposite side.

This vessel sometimes sends off large branches to the muscles at the lower part of the neck.

The VERTEBRAL *Artery*

Arises from the upper and posterior part of the subclavian. It goes upwards and backwards between the muscles which lie on the front of the spine, and passing under the transverse process of the sixth or seventh cervical vertebra, enters into the canal formed in the transverse processes of the vertebræ. In this course, as it proceeds from the third to the second cervical vertebra, it inclines outwards laterally, and, in its passage from the transverse process of

the second to that of the first vertebra, it forms a considerable curve, the convexity of which has a lateral and external aspect. After passing the transverse process of the *Atlas*, it is turned suddenly backwards, in a groove, and finally passes through the great occipital foramen into the cavity of the cranium. It then proceeds upon the cuneiform process of the occipital bone, under the *Medulla Oblongata*, and joins its fellow so as to form an acute angle with it near the union of the medulla oblongata with the pons Varolii. From each of the vertebral arteries before their union, there generally goes off a small branch called the *Posterior Meningeal*, which is spent upon the posterior part of the dura mater.

The trunk formed by the union of the vertebral arteries is called

The BASILAR Artery.

It extends forward near to the anterior part of the pons Varolii, where it bifurcates; but previously sends off several branches on each side. The first pair go off in a lateral direction, soon after its commencement, near the back part of the pons Varolii, and are spent upon the medulla oblongata, the pons Varolii, and the other contiguous parts, and also upon the fourth ventricle and the *Plexus Choroides* of that cavity. They are called the *Posterior* or *Inferior Arteries of the Cerebellum.*

Two other lateral branches, which are called the *Superior Arteries of the Cerebellum*, go off from the *Basilar* artery, near its anterior extremity. These are principally spent upon the crura of the cerebellum and cerebrum: upon the cerebellum itself, and the contiguous parts.

Soon after sending off the last mentioned arteries, the *Basilar* artery divides into two branches, which also take a lateral direction, and are of considerable

size. In their course outward, these branches are curved with their convexity forward. About ten or twelve lines from its commencement, each of them sends off a branch called the *Arteria Communicans,* which passes directly forward, and communicates with the internal carotid, thus forming the arrangement which is called the *Circle of Willis.** After sending off these arteries, they continue their lateral direction, and are distributed principally to the posterior parts of the cerebrum. These terminating branches of the *Basilar Artery,* are called the *Posterior Arteries of the Cerebrum.*

The SUPERIOR INTERCOSTAL *Artery*

Arises from the upper part of the *Subclavian,* after the *Vertebral* and *Thyroid* arteries, and very near them. It descends by the side of the spine across the first and second ribs, near their heads, and exterior to the great *intercostal nerve.* It generally forms two branches, which are appropriated to the muscles, &c. in the first and second intercostal spaces, and sometimes a small branch is continued to the third intercostal space. From each of these branches a small vessel proceeds backwards, and is spent upon the contiguous muscles, &c. on the back of the thorax. The *Intercostal Artery* also sends a branch upwards to the deep-seated parts of the neck.

In addition to the arteries above mentioned, there are several others of considerable size which originate either directly or indirectly from the SUBCLA-

* The arteria communicans is also considered as a branch of the *Internal Carotid.* The arrangement here alluded to is very remarkable. As the branches which pass off laterally from the single trunk of the *Basilar Artery* unite to the *Internal Carotids,* and the *Internal Carotids* are united to each other, there is an uninterrupted continuation of artery, which encloses a portion of space of a determined form; but this form resembles an oblong square more than a circle. By this connexion blood will pass from any one of the four arteries of the brain to all the others.

VIAN, and are spent upon the lower portion of the neck and the contiguous parts. These arteries are very different in different subjects, especially as to their origin. Two of them, which have been called the *Anterior* and *Posterior Cervicals,* are generally distributed to the muscles and other parts which lie on the lower portion of the neck anteriorly and posteriorly.

A third, which passes transversely on the lower part of the neck, is called the *Superior Scapular.*

In some cases, the two *Cervical Arteries* arise from the subclavian, after the mammary and the thyroid, in a common trunk, which soon divides. Very frequently they go off from the *Inferior Thyroid.*— Sometimes one of them goes off from the *Inferior Thyroid* and the other from one of the branches of the *Subclavian.**

The *Superior Scapular* most commonly arises with some other artery, and very often from the *Inferior Thyroid.* It runs transversely outwards within and above the clavicle, and passing through the notch in the upper costa of the scapula, divides into branches which are distributed to the parts on the dorsum of that bone.

The SUBCLAVIAN ARTERY, in its progress from the aorta to the axilla, forms an arch or curve, over the first rib, as has been already observed. The anterior scalenus muscle is before it, and the great nerves of the upper extremity are above it. After passing

* Haller paid great attention to the arterial system, and made many dissections, with a view to engravings of it, which he published with descriptions in folio fasciculi.

These fasciculi have been collected, and, with some other engravings, form a large volume, entitled ICONES ANATOMICÆ, which is truly valuable.

There are some very interesting observations on this work of Haller's, and also on these arteries, in a DESCRIPTION OF THE ARTERIES, by Dr. Barclay, of Edinburgh, which I have read with advantage, as well as a work on the muscles by the same author.

between the scaleni, it descends upon the first and second rib into the axilla. The nerves which are above descend with it; at first they are necessarily exterior to it; but they form a plexus which the artery enters into, so as to be partly surrounded by them. This course of the artery is obliquely under the clavicle, and behind the pectoral muscle. In the axilla, the vessel and nerves which surround it are placed between the tendons of the pectoralis and the latissimus dorsi muscles. Here the artery takes the name of AXILLARY, and sends off several important branches.

The *principal* branches that go off from the *axillary artery* are distributed,

1st. Anteriorly, to the pectoral muscle, and the parts on the anterior surface of the thorax.

2d. Posteriorly to the muscles which are on the scapula and contiguous to it; and,

3d. To the parts which are near the upper extremity of the os humeri.

Anterior Branches.

The arteries which go to the pectoral muscle, &c. are very various in different subjects, both as to their number, origin and size.

They have also been called by different names, as *Thoracicæ, Mammariæ, Externa, &c.*

There are almost always three of them, and very often more: one of them, which is called by several authors the *Acromialis*, proceeds towards the end of the clavicle, and generally passes out at the interval between the deltoid and the pectoral muscle, sending various branches to the contiguous parts; the largest of its branches often passing in the direction of the interstice between those muscles.

Another of these arteries, which is called *Superior*

Thoracic, is generally very small: it often is a branch of the above mentioned *Acromialis*.

There is very often to be found here an artery called the *Inferior Thoracic*, or the *External Mammary*, which is of considerable length, although its diameter is not very great. This artery originates near the two last mentioned, and sometimes from the *Acromialis*. It often extends downwards as low as the sixth rib, and sends branches to the anterior part of the thorax, to the mamma, and the other contiguous parts. Many of the small branches of this artery anastomose very freely with those of the internal mammary.

There are always *small arterial branches* in the axilla, which ramify upon the glands and adipose matter always existing there. They often arise by one common trunk, which is called the *Axillary Thoracic*.

Posterior Branch.

One large artery is commonly sent to the muscles on the scapula, which is called the *Scapular*, the *Common Scapular*, or the *Internal Scapular*. It commonly passes off from the axillary after the thoracic arteries, and supplies the muscles on both surfaces of the scapula. This large vessel passes downwards a short distance in the direction of the inferior costa of the scapula, and soon sends off a branch that winds round to the dorsum of the bone, to be distributed to the infra spinatus and the contiguous muscles, which is called the *Dorsalis Scapulæ*. The main trunk then inclines to the subscapularis muscle, and generally divides into two branches, which are distributed to the subscapularis, teres major, latissimus dorsi, &c.

Sometimes the *Scapular* artery divides into two branches before it sends off the dorsal. In this case

the last mentioned artery goes off from one of those branches.

Branches near the Os Humeri.

The arteries which are near the body of the os humeri, at its upper end, are generally two in number, and denominated the *Anterior* and *Posterior Circumflex*. Sometimes they arise separately, and sometimes in a common trunk from the AXILLARY artery. Frequently, one of them arises from the scapular.

The *Anterior Circumflex* passes between the united heads of the biceps and coraco-brachialis muscles and the body of the os humeri, at a small distance below its head. It sends branches to the capsular ligament, the periosteum of the os humeri, the membranes of the groove for the long head of the biceps, the upper portions of the biceps and coraco-brachialis, and some contiguous muscles.

The *Posterior Circumflex* proceeds between the subscapularis and teres major muscles, and continues between the os humeri and the head of the triceps and the deltoides. It is distributed to the muscles and parts about the joint, especially to the deltoides.

These arteries surround the os humeri, and the small branches anastomose with each other. The *Posterior Circumflex* is much larger than the *Anterior*.

The great artery of the arm proceeds from the axilla to the elbow; and, during this course, is generally denominated

*The HUMERAL Artery.**

Its direction is influenced by the position of the os humeri. When the arm hangs down, with the palm of the hand presenting forward, this direction is

* It is called the Brachial Artery by several writers.

somewhat spiral. The situation of the artery is on the inside of the biceps muscle, and between that muscle and the triceps extensor. It also continues very near and on the inside of the tendon of the biceps, and under the *Aponeurosis* which proceeds from that tendon. In consequence of the spiral or oblique course of the artery, its direction would be from the inside of the tendon of the biceps to the radial side of the fore-arm; but soon after it passes across the joint of the elbow, it divides into two branches: one which preserves, for some distance, the direction of the *Main Trunk*, is called the *Radial* artery: the other, which inclines obliquely downwards and towards the ulna, is the *Common Trunk* of the *Ulnar* and *Interosseal Arteries*.

During this course, the HUMERAL artery sends off several branches to the muscles and other parts on the os humeri. The largest of them is denominated the *Profunda Humeri* or *Spiralis*. This artery very often arises as high as the insertion of the latissimus dorsi, and passing between the heads of the triceps extensor muscle, proceeds downwards under that muscle in a spiral direction, towards the external or radial condyle. It sends several branches to the triceps and the contiguous muscles, and one considerable branch, which is generally called the *Profunda Minor*, to the parts contiguous to the internal condyle. The ramifications of these branches near the condyle frequently anastomose with small branches of the radial and ulnar arteries.*

A small branch frequently arises from the *Humeral* artery, at a short distance from the *Profunda Humeri*, which sends a ramification to the medullary

* The Profunda sometimes originates from the scapular, or one of the circumflex. The profunda minor sometimes has a distinct and separate origin, lower down than the other.

foramen of the os humeri. This vessel is, therefore, denominated *Arteria Nutritia.*

There are very often several anastomoses between the branches of the HUMERAL artery which originate above the elbow, and certain branches of the *Radial* and *Ulnar* arteries, which are so called from the direction recurrents. Among these arteries there is generally one of considerable size, which proceeds across the elbow joint near the internal condyle.— Sometimes this is the ulnar recurrent, which goes up to anastomose with the branches of the profunda; but more frequently it is a separate branch of the *Humeral* artery which goes off a little above the elbow, and passes across the articulation, near the internal condyle, to anastomose with the branches of the ulnar artery. This artery is denominated the *Anastomotica.*

There are often other branches sent off by the HUMERAL artery; but they are commonly small, and very irregular.

The two great ramifications of the HUMERAL artery on the fore-arm have very different directions. The *Radial* artery preserving the course of the main trunk, while the *Common Trunk* of the *Ulnar* and *Interosseal* projects from it in a direction downwards and towards the ulna, passing under the pronator teres, &c.

The RADIAL *Artery,*

Passing over the pronator teres muscle, proceeds between the supinator radii longus and the flexor carpi radialis, very near to the lower end of the radius, without changing its direction materially, being deep-seated above and superficial below; it then alters its course, and, passing under the tendons of the extensors of the thumb, to the back part of the ra-

dius, it continues between the metacarpal bones of the thumb, and of the index finger, when it divides into three branches.

In this course, it gives off but few branches. The first is the *Radial Recurrent,* which passes upwards and towards the external condyle, and frequently anastomoses with the ramifications of the profunda humeri.

The branches which it sends off between the origin of the recurrent and the lower end of the radius, are generally very small, and distributed to the parts immediately contiguous to the artery.—Before it turns under the tendons of the extensors of the thumb, it sends a branch over the wrist towards the root of the thumb, from which proceeds a branch to anastomose with the volar branch of the ulnar; and another, not so large, which is frequently continued on the radial or external side of the thumb, very near to its extremity. While the radial artery is under the aforesaid tendons, it sends off small branches to the back of the wrist and back of the hand, and often to the back of the thumb. Those which are distributed to the wrist and back of the hand, generally anastomose with the small branches of the ulnar and interosseal arteries.

The three branches into which the *radial* artery divides between the metacarpal bones of the thumb and index are, 1st, *a branch to the external side of the index;* 2dly, *a branch to the thumb,* that sometimes divides into two, which pass up on the anterior or volar surface, and sometimes continue, without much diminution, on the internal side of the thumb, near to the end of the last phalanx; and, 3dly, a branch, called *Palmaris Profunda,* which dips down into the palm of the hand, and proceeding in contact with the metacarpal bones, under the flexor tendons, &c. forms an arch which extends across the hand, and

often terminates by anastomoses with another arch, soon to be described, which is formed by the ulnar artery.

This flexure, which is denominated *Arcus Profundus*, sends off branches of a very small size, which are distributed to the bones, ligaments, muscles, &c. contiguous to it.

The COMMON TRUNK *of the* ULNAR *and* INTEROSSEAL *Arteries*

Passes under several of the muscles which originate from the internal condyle, and between the flexor sublimis and the flexor profundus. Before the *Ulnar Recurrent* goes off from this vessel, the *interosseal* artery often leaves it. This recurrent artery passes upwards between the muscles of the internal condyle, and distributes branches among them. It then passes up in the groove behind the internal condyle, and anastomoses with the branches of the *Anastomotica* or *Profunda Humeri*.

The ulnar and interosseal arteries separate from each other at the distance of fifteen or twenty lines from the origin of the *radial* artery, very near the commencement of the interosseal ligament.

The INTEROSSEAL *Artery,*

In a majority of cases, arises in a single branch from the common trunk of the ulnar and interosseal. When it does so, the single branch soon sends off the *Posterior Interosseal* artery, which perforates the interosseous ligament, and passes down on its posterior surface, while the main branch continues on the anterior surface of the ligament, and is denominated the *Anterior Interosseal Artery.* In some cases, the main branch proceeds on the anterior surface as low as the upper edge of the pronator quadratus muscle, before it sends off the posterior branch. Sometimes

the anterior and posterior interosseals arise separately. In this case the posterior soon perforates the ligament.

The *Anterior Interosseal* passes down almost in contact with the ligament, and gives branches to the contiguous parts in its course. It generally perforates the interosseous ligament near the wrist, and sends off many small branches to the back of the wrist and hand, which anastomose with the small branches of the radial and the posterior interosseal arteries.

The *Posterior Interosseal* soon gives off a recurrent or anastomosing branch, and then proceeds downwards towards the wrist, sending branches in its course to the extensor muscles and tendons.

This vessel sometimes divides into two branches.

The ULNAR *Artery.*

The *Ulnar* artery proceeds among the muscles obliquely downwards, and is not superficial until it has arrived within three or four inches of the carpus: it then continues towards the hand, sending off very small branches in its progress. It passes *over* the annular ligament at the wrist, and winds round the pisiform bone: here it is supported by a delicate ligament, which seems to lie upon it: from this it passes upon the palm of the hand, *under* the aponeurosis palmaris, and *over* the tendons of the flexors of the fingers. When thus situated, it forms, in perhaps a majority of subjects, an arch or bow, called *Arcus Sublimis,* which extends across the palm of the hand, from the ulnar towards the radial edge, and, after sending branches to the fingers, &c. from its convex side, terminates near the root of the thumb, by anastomoses with that important branch of the radial artery, which passes up on the inside of the thumb.

The *Arcus Sublimis* almost always sends off small branches to the integuments, &c. on the palm of the hand. It often sends off, near the root of the metacarpal bone of the little finger, a branch which passes between the flexor tendons and the metacarpal bones, and anastomoses with the *Arcus Profundus.* It then generally sends off a branch to the inner or ulnar side of the little finger; and afterwards three branches in succession, which pass from its convex side towards the angles formed by the fingers. These are called

The Digital Arteries.

When they have arrived near to the heads of the first phalanges of the fingers, each of these arteries divides into two branches, one of which passes along the side of one of the fingers to its extremity, and the other on the opposite side of the next finger: and in this way they pass on the sides of all the fingers, except the inside of the little finger, and the outside of the index.

These branches of the digital arteries are called *Digito Radial* and *Digito Ulnar* arteries, according to the sides of the fingers on which they are placed. They are situated on the angle, if it may be so termed, which is formed by the anterior and lateral surfaces of each finger. In their course from the basis to the extremity of the finger, they send off very small transverse branches, which anastomose with each other, especially near the other. Some transverse branches are observable on the posterior as well as the anterior surface. Near the extremity of each finger, beyond the insertion of the flexor tendon, the extremities of these arteries ramify minutely. Some of these small branches go to the skin, and others anastomose with their fellows of

the opposite side. Some also go to the back of the fingers.*

SECTION III.

Of the Branches which go off between the Arch and the great Bifurcation of the AORTA.

PART I.

In the Cavity of the Thorax.

THE aorta sends branches to the *Lungs*, to the œsophagus, and to the parietes of the thorax.

The BRONCHIAL *Arteries*

Are the vessels which go from the aorta to the ramifications of the trachea, and the substance of the lungs. They are not large, and are very irregular as to number and origin.

In a majority of cases the right lung is supplied, in part, by a branch from the first aortic intercostal of that side; while the left lung receives two or three branches from the aorta directly. In some cases a large vessel arises from the aorta, which divides into two branches, one of which goes to each lung.

* The distribution of the radial and ulnar arteries in the hand, is very different in different subjects.

Upon examining a large number of injected preparations in Philadelphia, it was found that, in a very small majority of them, the ulnar artery formed an arcus sublimis, whose branches extended as far as the ulnar side of the index, and sometimes beyond it.

That, in near a third of the preparations, the ulnar artery ramified without forming an arcus, and supplied only two of the digital branches, viz. the first two on the ulnar side. In such cases the radial artery generally made up the deficiency of the ulnar, but in a few instances the interosseal was extended on the palm of the hand, and supplied the radial side of the middle finger and the corresponding side of the index.

In a few instances also the ulnar artery was still more deficient, and the radial was proportionally extended.

The *Bronchial* arteries frequently send small branches to the posterior mediastinum, the pericardium, &c.

Injections have shown, that there is a direct communication between these vessels and the branches of the pulmonary artery.

The Œsophageal Arteries

Are very small vessels, which generally arise from the aorta, but sometimes are branches of the bronchials or intercostals that are spent upon the œsophagus. They occur in succession, and sometimes are five or six in number. They also send twigs to the contiguous parts, and the lowermost often descend to the stomach.

The Inferior Intercostals

Are the arteries which proceed directly from the aorta to the parietes of the thorax. Their name is derived from their position between the ribs. They are ramified on the intercostal muscles and ribs, and on the pleura and some of the contiguous parts. They are called *Inferior* or *Aorta Intercostals,* to distinguish them from the superior intercostals, which are derived from the subclavian artery. Their number varies from ten to eight, according as the superior intercostals are more or less numerous.

They originate in pairs on the posterior surface of the aorta. The uppermost of them pass obliquely upwards, and the lowermost nearly in a horizontal direction, to the lower edges of those ribs to which they are appropriated. They meet the rib near its tubercle, or place of junction with the transverse process of the vertebra, and then proceed forward, between the internal and external intercostal muscles, in a superficial but large groove, which is ge-

nearly to be found on the interior margin of the lower surface of the rib.* There is necessarily a difference in the length of the right and left intercostals, owing to the position of the aorta, which is rather on the left of the spine. In consequence of this circumstance, the œsophagus is anterior to, and also in contact with those of the right side.

They generally send off an important branch, called the *Dorsal*, which arises near their origin, and, passing backwards, sends ramifications to the muscles of the back. From this dorsal branch also proceeds a ramification, which enters the spinal cavity, and is spent upon its membrane and upon the medulla spinalis.

After the *Intercostals* in their progress forward, have passed beyond the middle of the ribs, they send off a branch, which generally proceeds very near to the upper side of the lower rib. The main trunk generally leaves the lower edge of the rib when it has arrived within one-third of the length of the bone from its anterior extremity. It then generally divides into several branches, some of which are spent upon the pleura, and others on the intercostal and the contiguous muscles.

According to the situation of the different intercostals, some of their ramifications communicate with those of the internal and external mammaries, of the phrenic, the lumbar, or the epigastric arteries.

* See Vol. I. page 103.

PART II.

In the Cavity of the Abdomen.

The AORTA passes into the cavity of the abdomen between the crura of the diaphragm, as has been already mentioned. In its course from the crura to its great bifurcation, it sends off one pair of small arteries, called *Phrenic,* to the diaphragm. Three single arteries, the CŒLIAC, the SUPERIOR, and the INFERIOR mesenteric, to the viscera of the abdomen. A pair of large arteries, the EMULGENTS, to the kidneys, with several that are very small to their appendages; as the *Spermatices, Capsular,* the *Ureteric,* and the *Adipose.* In addition to these, there is one pair of small arteries that go to the testicles, or to the ovaria and the uterus, and four or five pair, called *Lumbar Arteries,* that go off laterally, like the intercostals, to the parietes of the abdomen, and to the muscles, &c. on the back, which are contiguous to them.

The PHRENIC *Arteries*

Are ramified on the concave surface of the diaphragm, and are almost always two in number; they are denominated *right* and *left* from their position. They commonly originate separately from the aorta, but sometimes they arise in a common trunk which soon divides. In some instances they are derived from the cœliac. In a few cases, the aorta furnishes one, and the cœliac the other. Each of the phrenic arteries commonly crosses the crus of the diaphragm on its respective side, and proceeding laterally, in a circular direction, often ramifies so as to

form an internal and external branch. Each of them generally sends branches to the cardia or œsophagus, to the glandulæ renales, and other contiguous parts.

The CŒLIAC *Artery,*

Is the first great branch given off by the aorta in the abdomen, and is distributed almost entirely to the stomach, the liver and the spleen. It projects from the anterior part of the aorta so as to form a right angle with it, and is of course nearly horizontal, when the body is erect.

The main trunk of this great artery is so remarkably short, that it has been compared to the stump of a tree; for, at the distance of half an inch from its origin, it generally divides into three branches, which pass to the stomach, the liver, and the spleen, and are, therefore, denominated the *Gastric* or *Coronary,* the HEPATIC and the SPLENIC arteries.

The first mentioned branch may be called

THE SUPERIOR CORONARY OR GASTRIC ARTERY,

To distinguish it from other branches, soon to be described. It is commonly in the centre of the three great ramifications of the cœliac, and is also the smallest of them. It proceeds from its origin to the upper orifice of the stomach or cardia, and continues thence along the lesser curvature of that viscus until it approaches near to the pylorus. In this course it sends branches to the œsophagus, which frequently inosculate with the œsophageal arteries. It also furnishes branches to the cardia, which partially surround it; and, on this account, the artery has been called *Coronary.* Some of these last mentioned branches are often continued on the great extremity of the stomach, and anastomose with those ramifications of the splenic artery, called *Vasa Brevia.*

It continues on the lesser curvature between the

lamina of the small omentum, and sends off successively branches which pass between the peritoneal and muscular coats, and are distributed to the anterior and posterior surfaces of the stomach, communicating with the branches of the inferior gastric arteries, soon to be described.*

THE HEPATIC ARTERY

Proceeds from the great ramification of the cœliac to the transverse fissure of the liver called the *Portæ*, in which it generally divides into two branches. In this course it very frequently sends off an artery to the pylorus, which ramifies about the small extremity of the stomach, and often inosculates with some of the branches of the superior coronary. This branch is called the *Pylorica,* and sometimes it arises from the artery next to be mentioned.

The GASTRICA INFERIOR DEXTRA,

Which also generally originates from the main trunk of the hepatic, but sometimes from one of its branches. It is an artery of considerable size, which proceeds along the great curvature of the stomach, from the pylorus towards the great extremity between the lamina of the anterior portion of the omentum, and distributes its ramifications to both sides of the stomach, and also to the *Omentum.* In its progress from the hepatic artery to the stomach, it sends off branches to the *Duodenum* and to the *right end* of the *Pancreas.*

The two great branches into which the HEPATIC artery divides, are denominated *right* and *left,* from the lobes of the viscus to which they are respectively appropriated. The right branch is the largest.—

* This artery sometimes sends a branch to the liver. When this is the case, it is always very large.

Before it penetrates the substance of the liver, it sends off a branch to the gall bladder, called the *Cystic Artery.*

The branches of the hepatic artery ramify very minutely in the liver, as has been stated in the account of that organ.

The last great branch of the cœliac is

The SPLENIC *Artery,*

Which is generally supposed to be larger than the hepatic in adults, although it is less in children. It proceeds in a transverse direction from its origin to the spleen: its course is not straight, but meandering or serpentine. It is situated behind and above the pancreas, and passes along the groove in the upper edge of that viscus. In its progress, it sends off many small branches, and one that is of considerable size, to the *Pancreas.* It also sends one branch to the left extremity of the stomach, which arises commonly from the main trunk, but sometimes from the ramifications, which are soon to be mentioned. This branch, which is called

The GASTRICA INFERIOR SINISTRA,

Is sometimes, but not often very large: its course is from left to right. It is situated between the lamina of the anterior portion of the omentum. It sends some small branches to the omentum, and others which are larger and more numerous, to both sides of the stomach. Some of these last mentioned anastomose with the ramifications of the gastrica dextra which come from the hepatic.

When the SPLENIC artery approaches near to the spleen, it divides into four, five, or six branches, each of which penetrates into that viscus by a dis-

tinct foramen, and then ramifies in the manner described in the account of the structure of the spleen.*

Either from the splenic artery, or from these ramifications, four or five branches pass to the large extremity of the stomach, and ramify there, communicating with the vessels already described. These arteries have received great attention from physiologists, and are denominated *Vasa Brevia.*

The SUPERIOR MESENTERIC,

Which is the second great branch given off in the abdomen by the aorta, is not very different in size from the cœliac, and originates about half an inch below it. It is distributed to the small intestines; to that portion of the great intestine, which is situated on the *right side* of the abdomen; and to the *arch* of the colon. From its origin it proceeds downwards, under the pancreas, and over the lower portion of the duodenum, to the commencement of the mesentery. When it has arrived between the lamina of that membrane, it descends in a direction which corresponds with that of the root of the mesentery,† and forms a gentle curve, with its convexity directed towards the intestines. It necessarily diminishes as it descends, and generally terminates by anastomosing with one of its own branches.—This great artery sends off some very small ramifications to the pancreas and the duodenum, while it is in their vicinity. It also sends two or three branches to the transverse part of the colon, to the right portion of the colon, to the beginning of the great intestine, and the contiguous portion of the ileon. These branches are commonly termed the *Colica Media*, *Colica Dextra*, and *Ileo*

* It frequently happens that the splenic artery divides only into two or three branches, and they subdivide so as to form five or six, which penetrate the spleen.

† Vol. II. p. 115.

Colica. From the convex side of the curve, the SUPERIOR MESENTERIC sends off the important branches which pass between the lamina of the mesentery, and supply the *Small Intestines.* These branches are numerous, and many of their ramifications anastomose with each other, so as to form arches. From these arches go off other branches, which anastomose again with some of similar origin; and this process is repeated successively several times, so that a net-work of blood vessels seems to be formed on the mesentery. From the mesentery the small ramifications are continued, in great numbers, to the intestines. Some of them anastomose with eaeh other on the coats of the intestine; but an immense number of minute arteries are continued to the villous coat, so that, when they are successfully injected, the surface of that coat appears uniformly coloured by the injection.*

The INFERIOR MESENTERIC Artery

Does not go off from the aorta next in order after the superior mesenteric, but succeeds it immediately on the intestines, and continues the arterial ramifications to the *left portion of the colon,* to which the branches of the superior mesenteric do not extend.

This artery arises between the origin of the emulgents and the great bifurcation of the aorta, and proceeds downwards, inclining to the left, but keeping near to the aorta. There are generally three branches distributed to the left portion of the colon, which arise from this artery, either separately, or by a common trunk which soon divides. It frequently happens, that one of these arteries arises separately, and two by a common trunk. These are called the *Left*

* See the account of the termination of these arteries, at page 110 of this volume.

Colic arteries; and are also sometimes denominated, from their position, *Superior*, *Middle*, and *Inferior*. The *Superior* generally anastomoses with that branch of the superior mesenteric, which is called *Colica Media*, and forms a remarkable arch, called the *Great Mesocolic Arch*. The ramifications of the other branches frequently anastomose with each other, and are finally spent upon the left portion of the colon.

The main trunk, diminished by sending off these branches, but still of considerable size, runs downwards on the posterior part of the intestine rectum, between that intestine and the sacrum, where it often divides into two branches, which continue near to the termination of the rectum. From them proceed many ramifications that are spent upon the rectum. Some of these ramifications anastomose with each other, and others with the ramifications of the hæmorrhoidal artery, soon to be mentioned.

The EMULGENT *or* RENAL *Arteries*

Are the large vessels which pass from the aorta to the kidneys. They arise between the superior and inferior mesenterics, one on each side; and proceed in a direction which is nearly rectangular to the aorta. The right emulgent artery is necessarily longer than the left, and it generally passes behind the vena cava. When they approach near the concave edges of the kidneys, each emulgent commonly divides into three or four branches, which pass into the fissure of that organ, and ramify in the manner described in the account of it. Sometimes two arteries proceed from the aorta to the kidney; but this is not a frequent occurrence.

The Capsular Arteries

Are the small vessels which pass to the glandulæ

renales. There are almost always several of them appropriated to each gland. They often arise on each side from the cœliac artery, the aorta, and the emulgent.

The Adipose Arteries

Supply the adipose substance surrounding the kidneys.—There are several of them on each side, and, like the last mentioned arteries, they are very small, and arise from several sources as well as the aorta.

The testicles and ovaria are supplied by the

Spermatic Arteries,

Which are very remarkable for their great length and small diameter. In a majority of cases, these vessels arise from the anterior surface of the aorta, a little below the emulgents: but it often happens that the left spermatic arises from the emulgent on that side. They also sometimes arise from other neighbouring arteries. It has been observed, when they arise from the aorta, that the origin of one of them is generally higher than that of the other.

They pass downwards, so as to form an acute angle with the aorta, and proceed behind the peritoneum, and before the psoas muscle and ureter. While this artery is in contact with the psoas muscle, it meets with the ramifications of the *spermatic vein*, and, in its progress to the abdominal ring, also joins the *spermatic cord*. In this course, it sends off some very small twigs to the contiguous parts, and others that anastomose with similar ramifications from the mesenteric, epigastric, &c. Before it arrives at the testicle, it divides into several branches, two of which generally go to the epididymus, and the others penetrate the upper and back part of the tunica albuginea.

The Spermatic Arteries in the Female,

Instead of passing to the abdominal ring, proceed between the lamina of the broad ligaments, and send branches to the ovaria, which, in some cases, may be traced to the vesicles. They also send branches to the Fallopian tubes and uterus, and to the round ligaments. Those which are on the opposite sides of the uterus, anastomose with each other, and with the branches of the hypogastric arteries.

The lumbar regions are supplied with arteries which originate, like the intercostals, from the posterior part of the aorta between the thorax and pelvis. There are four or five of these vessels on each side, and they are denominated

The Lumbar Arteries.

They pass between the spine and the psoas muscle, and send branches to the spinal cavity, to the muscles of the lumbar regions, and the abdominal muscles. They anastomose with the internal mammary, the epigastric, the circumflex of the ilium, &c.

A small artery passes off singly from the posterior part of the aorta at its bifurcation, which is called

The Middle Sacral Artery.

It proceeds down the middle of the sacrum to the os coccygis, and sends off lateral branches, which are spent upon the contiguous parts, and inosculate with the arteriæ sacræ laterales.

SECTION IV.

Of the Arteries which originate at and below the Great Bifurcation of the Aorta.

The PRIMITIVE ILIACS

Form an acute angle with each other. They proceed downwards behind the peritoneum, very near the margin of the pelvis, without sending off any branch of importance. At the junction of the sacrum with the ossa ilea, they divide into two great branches: the INTERNAL ILIAC, or HYPOGASTRIC, which descends into the pelvis; and the EXTERNAL ILIAC, which passes under the crural arch to the lower extremity.

The INTERNAL ILIAC, or HYPOGASTRIC,

Is distributed, in part, to the viscera of the pelvis and the organs of generation, and also to the large muscles exterior to the pelvis: it is, therefore, very large, though not quite equal to the EXTERNAL ILIAC.

It has already been mentioned, that, in the fœtal state, this vessel appears to continue in a curved direction from its origin to the lower part of the side of the bladder, and from thence to the Umbilicus, under the denomination of the *Umbilical artery*. From the convex side of this curve the different branches of the internal iliac go off. In the fœtal state they are very small, in proportion to the umbilical artery; but as the artery becomes ligamentous, these branches increase in size.

In the adult, the arrangement of these vessels is very different. The INTERNAL ILIAC generally divides into two great branches; the *Gluteal*, which passes through the sacro-sciatic notch, and ramifies

on the exterior and upper part of the os ilium: and the *Ischiatic*, which passes downwards on the outside of the tuberosity of the ischium.

The first of these large ramifications passes out of the pelvis above the pyriform muscle, and the last of them below it. Several smaller arteries arise from these branches near their origin, or from the main trunk of the internal iliac, which are distributed to the different parts of the pelvis; and one important branch of the ischiatic, called the *Pudic*, proceeds downwards on the inside of the tuberosity of the ischium.

The first of the smaller branches which the external iliac commonly sends off, is called the

Ileo Lumbalis:

It sometimes arises from the gluteal artery, and sometimes from the main trunk of the internal iliac. It passes outwards under the psoas muscle, and suddenly divides into two branches. One of them proceeds upwards, and is distributed in the lumbar region, while the other ramifies on the iliacus internus muscle, and is spent on the contiguous parts.

There are, also, two or three small arteries called

Arteria Sacræ Laterales,

Which sometimes arise singly, and sometimes in common, from the great trunk. They also occasionally originate from the gluteal artery. These vessels enter the anterior foramina of the os sacrum, to be distributed on the cauda equina and the membranes which invest it. Some of their ramifications anastomose with branches of the sacra media and other contiguous arteries.

On the anterior side of the internal iliac, near the origin of the above mentioned vessels, a ligament, which was originally the *umbilical* artery, goes off to

the side of the bladder, and continues from thence to the umbilicus. Sometimes it continues pervious for a short distance, and then small branches pass from it to the bladder.

In the female it also sends small branches to the uterus and vagina.

In addition to these *Vesical Arteries* derived from the umbilicals, there are other branches distributed to the bladder, which arise very differently, in different subjects, from branches which are soon to be described, as the hemorrhoidal, pudic, &c.

From the anterior side of the internal iliac, or from one of its great branches, an artery often arises which passes out of the pelvis through the aperture in the margin of the ligamentous membrane which closes the foramen thyroideum of the os innominatum; this is called the

Obturator Artery.

This vessel, while it is in the pelvis, often sends small branches to the bladder and its appendages, and to the obturator internus muscle. After it passes out of the pelvis, it frequently divides into branches; some of which are spent on the obturator externus, and the contiguous muscles and others, go to the hip joint. The origin of this artery is variable. Most commonly it arises from the internal iliac, but often from the ischiatic, and sometimes from the gluteal. In some instances, it originates in a way that is particularly interesting, when the operation for crural hernia is to be performed, viz. from the *epigastric artery*, soon to be described: for in this case the obturator artery sometimes nearly surrounds the neck of the hernial sac.*

* See Astley Cooper's great work on Hernia, Vol. I.
There is reason to believe that this position of the artery occurs more frequently than has been supposed.

A small artery passes from the internal iliac or one of its branches, to the rectum, which is called the

Middle Hæmorrhoidal,

From its situation between the branches which are sent to that intestine from the inferior mesenteric, and those which go to it from the pudic. This artery is spent upon that part of the rectum which is above and in contact with the sphincter. It sends branches to the prostate and vesiculæ seminales in males, and the vagina and bladder in females.

In females there is a peculiar artery,

The Uterine,

Which originates either from the internal iliac, near the origin of the ischiatic, or from one of its branches. It passes between the lamina of the broad ligaments to the cervix uteri, and penetrates the texture of that organ. The size of this vessel varies with the varying size of the uterus.

The GLUTEAL *or* POSTERIOR ILIAC *Artery,*

One of the two great branches of the internal iliac, proceeds exteriorly through the sciatic notch *above* the pyriform muscle, very near the edge of the bone. On the outside of the ilium it generally divides into two branches, one of which ramifies between the gluteus medius and minimus, and the other between the medius and maximus. It is principally spent upon these muscles, and sends branches to the contiguous parts.

The ISCHIATIC *Artery,*

The other great branch of the internal iliac, passes through the sciatic notch *below* the pyriform muscle, and proceeds downwards, between the great trochanter of the os femoris and the tuberosity of the ischium, under the gluteus maximus muscle. Soon after its

origin, it *commonly* sends off a considerable branch, the *Arteria Pudica,* which also passes downwards: it then continues its course as above mentioned, and its principal branches are distributed to the gluteus maximus and the muscles of the upper and back part of the thigh, while its smaller branches go to the os sacrum and coccyx, and the contiguous small muscles.

The PUDICA INTERNA,

As has been just mentioned, is often a branch of the ischiatic artery, but sometimes originates immediately from the internal iliac. It proceeds downwards and inwards, diverging from the ischiatic, and passing between the two sacro-sciatic ligaments to the interior side of the tuberosity of the ischium, whence it continues on the inside of the crus of the os ischium and pubis until it approaches the symphisis, when it generally divides into three branches, which are spent upon the organs of generation, from which circumstance the name of this artery is derived.

One or more branches from it also pass to the lower part of the rectum and sphincter ani, and are called the *Lower Hæmorrhoidal Arteries.*

In its course, it sends off many small branches to the contiguous parts; one of which, called the *Perineal,* leaves it near the transversus perinei, and passes between that muscle and the skin, and between the bulb of the urethra and the crus of the penis, to the scrotum.

When the *Pudic* has arrived near the bulb of the urethra, it sends a branch into it, which is continued into the corpus spongiosum urethræ, and ramifies there minutely.

At the symphisis of the pubis it sends off a second branch, which passes to the back of each crus, and, proceeding along it, parallel to its fellow, terminates

in the glans penis: in this course it sends branches to the elastic coat, to the integuments, and to the prepuce. This vessel is called the *Arteria Dorsalis.*

The main trunk of the pudic artery then penetrates the corpus cavernosum, and proceeds through it in a straight direction. Its ramifications appear to be distributed through the internal structure of the corpus cavernosum, and some of them extend through the septum to the other side, while others pass to the corpus spongiosum urethræ.

The EXTERNAL ILIAC,

The great artery of the lower extremity, appears soon after birth, like a continuation of the primitive iliac, and proceeds along the brim of the pelvis behind the peritoneum, to Poupart's ligament, or the crural arch, under which it passes.

The psoas muscle is at first in contact with it on the outside, and the internal iliac vein on the inside. As it passes under Poupart's ligament, it is immediately anterior to the psoas and iliacus internus muscles, where they are united, and the crural nerve is exterior to it. Before it arrives at the lower edge of Poupart's ligament, it sends off

The Epigastric Artery,

Which arises on its internal side, and proceeds downwards and inwards about half an inch; then it turns upwards and inwards, and continues in that direction for a small distance, after which its course is less oblique. It passes between the peritoneum and the abdominal muscles, behind the spermatic cord, and the round ligaments in females.

It generally changes its oblique direction after passing about two inches, and then proceeds in con-

tact with the rectus, and very near its external edge, its ramifications are expended upon the anterior parietes of the abdomen; and after it has arrived as high as the umbilicus, it commonly divides into branches, which often inosculate with the ramifications of the internal mammary.*

An artery which is rather smaller than the epigastric, arises nearly opposite to it, but rather lower, from the external side of the external iliac. It is called

The Circumflex Artery of the Os Ilium,

And proceeds upwards and outwards to the upper margin of the os ilium, along which it continues very near to the spine. It is distributed principally to the abdominal muscles, to the iliacus internus and the psoas, and the parts contiguous.

The artery of the lower extremity, after passing under Poupart's ligament, takes the name of

FEMORAL *Artery,*

And proceeds downwards in a direction so spiral, that although it is in front at the upper part of the thigh, it is completely behind at the lower part. It sends branches to the muscles of the thigh, as the aorta does to the viscera of the abdomen, viz. by a few large vessels which extend and ramify to a great distance among them.

The situation of the abductor muscles, and their attachment to the os femoris, is such, that the artery in this course must necessarily perforate their com-

* Several respectable surgeons have been taught by experience, that when the abdomen is distended by ascites, the position of the epigastric artery is so much altered, that it will sometimes be found in the middle of the oblique line, which extends from the umbilicus to the superior anterior spine of the ilium.

mon tendon, which it does at the distance of one-third of the length of the bone from its lower end. The aperture in this tendon corresponds precisely with the general course of the artery; and before the artery enters this perforation, it is on the internal side of the bone; after it has passed the perforation, it is on the posterior side of it. After passing through the tendon of the abductors, it is denominated *The Popliteal Artery*, and it retains this name until it divides.

It then proceeds downwards, being very near the bone, and between the tendons of the flexors of the leg, covered by the great nerve of the lower extremity, and very often, also, by the vein. After crossing the articulation of the knee, when it is between the heads of the gastrocnemii muscles, at the lower edge of the popliteus muscle, it divides into the anterior tibial and the common trunk of the peroneal and posterior tibial arteries.

The FEMORAL artery, soon after emerging from Poupart's ligament, sends off very small branches to the inguinal glands, and other contiguous parts. It also sends off the

External Pudics,

Which are two or three small arteries that are generally spent upon the scrotum in males, and the *Labia Pudendi* in females.

About two inches below Poupart's ligament, the great branch which has been called the muscular artery of the thigh, leaves it. This vessel is commonly denominated

ARTERIA PROFUNDA.

It arises from the back part of the trunk of the femoral, and passes downwards and backwards, in a way that has been compared to the separation of

the internal iliac and the external. Very soon after its origin, it sends off two branches, which proceed, one on the internal, and the other on the external side of the thigh, and are called the circumflexa interna and externa. It then passes downwards behind the trunk of the femoral, and sometimes very near it, on the adductor muscles, and finally divides into branches, which are called the *Perforating*.

The External Circumflex

Sometimes arises from the femoral, but most commonly is a branch of the profunda, as above stated. It passes under the rectus and tensor vaginæ femoris towards the great trochanter, and generally divides into two branches, one of which continues in the transverse direction, and sends branches to the upper and back part of the thigh, and the parts contiguous to the joint; while the other descends in the course of the rectus femoris muscle, and some of its ramifications extend near to the outside of the knee.

The Internal Circumflex

Is often smaller than the other. It generally passes between the psoas, and the pectineus muscles, and continues round the thigh towards the lesser trochanter. Its ramifications are expended on the upper portions of the adductor muscles and the muscular parts contiguous to the lesser trochanter. It also sends branches to the articulation.

The Perforating Arteries

Are two or three ramifications of the profunda, which pass through the adductor muscles, and are expended upon the flexor muscles on the back of the thigh. Some of the terminating branches of the profunda itself are also called perforating arteries.

The next branch of importance which is sent off

by the FEMORAL artery, leaves it before it enters the aperture in the tendon of the adductors, and is called

The Anastomotic Artery.

This vessel soon inclines downwards. Its ramifications extend into the vastus internus muscle; some of them follow the tendon of the adductors, and ramify about the internal condyle.

Several small branches go off from the great artery soon after it passes through the tendon of the adductors, which are distributed to the contiguous muscles. Some of them are also called

Perforating Arteries.

Among them is the principal *Medullary Artery* of the os femoris.

In the ham, the great vessels there called

POPLITEAL,

generally send off several small branches. Two of them go off on the inside, one above and the other below the knee; and two on the outside in the same manner. They are named, from their situation, *The Superior and Inferior Internal,* and *The Superior and Inferior External Articulary Arteries.*

The *Superior Internal* artery perforates the tendon of the adductors above the internal condyle, and ramifies minutely on the inner side of the joint.

The *Superior External* artery passes through the lower portion of the biceps above the external condyle, and ramifies minutely on the outer side of the joint. Its superior ramifications anastomose with those of the descending branch of the external circumflex, while its inferior ramifications communicate with those of the corresponding artery below.

The two inferior arteries originate nearly opposite to the middle of the joint, and pass downwards.

The *Inferior Internal* artery passes under the

internal head of the gastrocnemius muscle, on the posterior and internal side of the head of the tibia. Its ramifications communicate with those of the corresponding artery above and of the tibialis antica below. They also extend to the interior of the joint.

The *Inferior External* artery passes under the external head of the gastrocnemius and the plantaris muscle, and continues under the external lateral and capsular ligament. It is distributed on the external and inferior part of the articulation, and sends also some branches to the interior of the joint.

There is frequently an azygous vessel, called the *Middle Articular* artery, which arises from the back of the popliteal, and is distributed to the posterior part of the articulation.

The POPLITEAL artery, after this, sends off a few small branches to the heads of the muscles of the leg, and among them one of considerable length, to each of the heads of the gastrocnemii. At the under edge of the popliteus muscle, it sends off horizontally a large branch, which passes directly forward between the tibia and the fibula, above the commencement of the interosseous ligament. After this, it continues to descend, nearly in the same direction, under the soleus muscle, behind the tibia; but before it has proceeded farther than twelve or fifteen lines, it sends off a branch which forms an acute angle with it, and approaches near the fibula, along which it descends.

The branch sent off anteriorly, is called the *Anterior Tibial* artery.

The main trunk, which continues downwards, is called the *Posterior Tibial* artery;

And the branch which descends near the fibula is called the *Peroneal* or *Fibular* artery.

The ANTERIOR TIBIAL *Artery,*

After its arrival on the anterior part of the leg, passes down close to the interosseous ligament, with the tibialis anticus muscle on the inside, and the extensor communis on the outside, in the first part of its course; and afterwards, with the extensor pollicis pedis on the outside of it. It gradually inclines internally as it descends, so that a little above the ankle it is upon the front part of the tibia. It proceeds thence with the tendons of the extensor digitorum pedis, under the annular ligament, to the upper surface of the foot, on which it continues to the interstice of the first and second metatarsal bones, where it descends to anastomose in the way presently to be mentioned.

In this course it sends off, soon after it has arrived at its anterior situation, a *recurrent branch,* which is distributed to the heads of the muscles and the ligaments of the articulation, and which anastomoses with the branches of the inferior articular arteries. It also sends off, on each side, many arterial twigs to the contiguous muscles, and very frequently one branch of considerable size, which passes down near the fibula.

When it has arrived near the end of the tibia, it sends a branch on each side, called the *Internal* and *External Malleolar.* On the top of the foot, among several smaller arteries, it sends off a branch under the extensor brevis digitorum pedis, which passes outwards and forwards, and supplies the muscles, &c. on the upper part of the foot. This vessel is called *Arteria Tarsa.* There is also another branch, called *Metatarsa,* which generally arises about the middle of the foot, and passes obliquely outward and forward, supplying the contiguous parts.

The *Anterior Tibial* artery, having arrived at the space between the metatarsal bones of the first and second toes, bends down to the sole of the foot, but previously sends off a branch which passes near the external edge of the metatarsal bone of the great toe, and divides into two branches, one of which goes to the outside of the great toe, and the other to the opposite side of the toe next to it.

The POSTERIOR TIBIAL *Artery*

After sending off the anterior tibial, parts with the *Peroneal* or *Fibular*, as has been already stated, and then continues on the back of the tibia, behind the internal ankle, to the sole of the foot.

The Peroneal or Fibular Artery

Is not commonly so large as either of the two other arteries of the leg, nor is it so constant. It passes down very near the internal edge of the fibula. It is in contact, for some distance, with the tibialis posticus muscle, and is anterior to the soleus and the flexor pollicis longus; it sends branches to the contiguous muscles. After it has passed along two-thirds of the length of the fibula, it frequently, but not always, divides into an anterior and a posterior branch.

The *anterior peroneal* soon perforates the interosseous ligament, and passing down some distance on its anterior surface, continues to the ankle and upper surface of the foot. It gives ramifications to all the contiguous parts in its progress, and anastomoses with some of the small ramifications of the tibialis antica.

The *posterior peroneal branch* is the continuation of the main trunk. It passes behind the external malleolus, and ramifies upon the external side of the foot.

The *posterior tibial* artery passes down, inclining rather obliquely inwards, between the gastrocnemius internus, which is posterior to it, and the tibialis posticus and flexor digitorum, which are anterior to it. Upon the leg it gives off many small branches, one of which, termed the *Arteria Nutritia Tibiæ*, comes off high up,* and, after ramifying as it descends, sends a branch to the medullary foramen of the tibia.

At the lower part of the leg the *Posterior Tibial*, is situated rather superficially between the tendo Achillis and the tibia. It proceeds thence behind the internal ankle in a deep situation, covered by an annular ligament, and passes between the abductor muscle of the great toe and the bones of the tarsus. It then divides into two branches—the *internal* and the *external plantar* arteries.

The Internal Plantar Artery

Is commonly much smaller than the other ramification. It passes in the direction of the internal edge of the foot, but at some distance from it, and often lies between the aponeurosis plantaris and the abductor pollicis. It frequently terminates by anastomosing with one of the arteries of the great toe, and in its course sends off several branches to the contiguous parts on each side of it.

The External Plantar Artery

Is the continuation of the main trunk. It proceeds outwards and forwards between the short flexor of the toes and the flexor accessorius; and continues afterwards between the first of these muscles and the abductor of the little toe. At the metatarsal bone of

* This artery sometimes comes off from the popliteal.

the little toe it begins to curve, and continues its curvature across the other metatarsal bones to the interstice between the great toe and the one next to it, *passing between the tendons of the long extensor and the metatarsal bones.* At the interstice above mentioned, it anastomoses with the tibialis antica. The curvature, thus formed, is called the *Arcus Plantaris.*

In this course, the *External Plantar* sends off several branches to the heel and the parts of the foot, especially on the external side; the deep-seated parts of the foot being supplied from the curve.

Digital branches go off from the curve, as they do in the hand, from the curve of the ulnar. There is first a small branch to the outside of the little toe, and then three regular branches, which pass to the junction of the roots of the four small toes, and divide, like the digital arteries of the hand, so as to send a branch to the side of each toe. These digital arteries pass between the muscle called *Transversalis Pedis* and the metatarsal bones. Near the heads of these bones, each of them generally sends off two arteries that pass upwards between the interossei muscles and the bones, and anastomose with the ramifications from the top of the foot.

The External Plantar, soon after sending off the third digital artery, anastomoses with the anterior tibial, and then continues to the junction of the root of the great toe with the one next to it, when it divides into two branches, which go to the opposite sides of those toes. In its course it also sends a branch to the internal side of the great toe.

CHAPTER III.

OF THE PARTICULAR DISTRIBUTION OF THE VEINS.

Anatomists of great respectability have very different sentiments respecting the best method of describing the veins. Some of them, in order to follow the course of the circulation, commence with the small veins, and proceed to the large trunks which are formed by their union. Others begin with the great veins that empty into the heart, and proceed from them to the small ramifications of the venous system, in a direction the reverse of the circulation.

As the last method is the easiest for the student of anatomy, it will be adopted here; but it must always be kept in mind, that the blood flows from the small veins into the larger, and not from the latter into the former, as the mode of description seems to imply.

The great trunk of the venous system differs considerably from that of the arterial with respect to its connexion with the heart; for it communicates with that organ in such a manner, that, when viewed from before, it appears like two vessels; one opening into the upper, and the other into the lower part of the right auricle. When viewed from behind, it appears like a continued tube, three-fourths of which are deficient anteriorly; and to the margin of this deficiency the right sinus or pouch of the heart is connected.

In some preparations of the heart, where all the great vessels connected with it are much distended by the injection, and the pulmonary vessels are in-

jected first, the right auricle is so much pressed upon from behind, by the vessels which go to the right lung, that the direction of the superior and inferior portions of the vena cava, which thus communicate with it, is altered. Each of them is turned obliquely forwards, so that it forms an angle with the other. This occasions them to appear more like distinct vessels than they otherwise would do.

The above mentioned portions of the great veins are denominated the *Superior* or *Descending*, and the *Inferior* or *Ascending Vena Cava;* as if they were perfectly distinct and unconnected with each other.

The CORONARY *Veins*,

Which are exclusively appropriated to the heart, may be considered here, as they are not included in the general arrangement of the veins.

The great vein of the heart begins at the lower part of the right auricle, very near to the septum, which divides the two auricles. It soon proceeds to the left in a circular direction, surrounded with adipose matter, in the deep groove which exists between the left auricle and the left ventricle. It continues between the auricle and ventricle, until it is immediately over the septum, which divides the two ventricles. Here its direction changes, and it proceeds to the apex of the heart, where its small ramifications anastomose with others soon to be described. In its course round the basis of the left ventricle, it sends off several branches, one of which is considerable, that proceed from the basis towards the apex of the heart, ramifying on the surface of the left ventricle.

A second vein, much less than the first, appears to proceed from the great vessel at its commencement,* and continues on the lower flat surface of

* It often opens into the auricle by a separate orifice.

the heart, between the two ventricles, to the apex, accompanied by a branch of the right coronary artery. This has been called the *Middle Vein* of the heart.

In addition to these there are several veins which begin at the right auricle, and extend on the surface of the right ventricle towards the apex of the heart. These have been called the *Anterior Veins*.

SECTION I.

Of the SUPERIOR *or* DESCENDING VENA CAVA, *and the Veins which communicate with it.*

THIS great vessel proceeds upwards from the superior and posterior part of the right sinus or pouch of the heart;* and a portion of it is so involved by the pericardium, that it seems to be included in that sac, as the heart is in this situation. It is somewhat anterior as well as to the right of the aorta. It continues above the pericardium, adhering to the right lamen of the mediastinum, and rather inclining forward. When it is as high as the lower margin of the upper rib, it sends off a very large branch, which conveys the venous blood of the *left* arm and the *left* side of the head and neck. This large vein, which is very important, both on account of its size and its situation, proceeds in a transverse direction within the sternum, almost in contact with, and but little below, the upper and internal margin of that bone. Immediately behind, or within the origin of the left sterno-mastoid muscle, it divides into the left subclavian, which preserves a transverse course, and the left internal jugular, which proceeds to the cavity of the cranium by the foramen lacerum.

After sending off this transverse branch to the

* See the description of the heart in page 51, of this volume.

left, the great vein continues upwards and behind the right sterno-mastoid muscles, and there sends off, nearly at right angles, the right subclavian vein. After it has parted with this vein, it takes the name of *Internal Jugular*, and continues to the right foramen lacerum, in the basis of the cranium. The superior vena cava is, therefore, principally formed by the union of the subclavians and internal jugulars from each side of the body.

Immediately after the superior cava rises above the pericardium, before it divides as above stated, it sends off, from its posterior part, a large vein which is single, and, therefore, called

VENA AZYGOS.

This vessel projects backward above the right pulmonary artery and right branch of the trachea, and then curves downwards behind them. It proceeds down the spine to the right of the aorta and at a small distance from it, into the abdomen, between the crura of the diaphragm, and sometimes between some of the portions of that muscle, which are attached to the dorsal vertebræ. In the abdomen it often anastomoses either with the lumbar veins or the vena cava.

The azygos frequently sends off several small veins from its curvature to the contiguous parts, and also the right *Bronchial Vein*, which passes along the ramifications of the trachea into the substance of the lungs.* In its course downwards it gives off branches to the œsophagus, some of which are considerable.

The *Inferior Intercostal Veins* originate directly or indirectly from the azygos. In some cases there is no superior intercostal on the right side; and then

* This bronchial vein sometimes arises from the superior cava.

the two or three uppermost of the right intercostals are also derived from the azygos; and often originate from it by a common trunk, which soon divides. Most commonly the ten inferior intercostals *on the right side* proceed directly from the azygos, and accompany the intercostal arteries. Their posterior branches pass into the vertebral cavity, and communicate with the veins which are there.

About the sixth or seventh rib, the vena azygos frequently sends off a branch to the left, which descends on the left side of the vertebræ, and sends off those *left* intercostal veins which are below its origin. It passes through the diaphragm with the aorta, or to the left of it, and anastomoses either with the azygos itself, or in a way which is analagous to the anastomosis of that vessel.

The *Vena Azygos* may be regarded as the great trunk of the veins of the parietes of the thorax, which are thus collected, because they could not with convenience pass singly to the vena cava, as the arteries do to the aorta.

Soon after sending off the vena azygos, the *Superior Cava* sends off the great transverse branch above mentioned. From this it continues upwards but a short distance, when it divides, behind the right sterno-mastoid muscle, into the right subclavian and right internal jugular.

The branches of the superior cava, which thus intervene between the great trunk and the subdivisions behind the sterno-mastoid muscles, are often called the *Subclavian Veins;* but they do not appear to be accurately named. For, 1st, they are not situated under the clavicle, and, 2dly, they are the common trunks of the subclavians and internal jugulars united.

There is a difference in the places where some of the smaller veins originate on each side. The inter-

nal mammary and the inferior thyroid, on the right side, arise from the superior cava, or from the subclavian at its origin. On the left side they arise from the subclavian.

The SUPERIOR INTERCOSTAL *Veins*

Are somewhat different on the two sides. *That on the right* is often the smallest and the least extensive. It commonly originates from the posterior and inferior part of the subclavian opposite to the origin of the vertebral, and is generally distributed to the first and second intercostal spaces, but rarely to the third.

The Left Intercostal frequently originates near the left internal mammary, and sometimes in common with it. It descends behind the aorta on the left of the spine, and commonly sends off the six upper intercostal veins, of which the two or three superior pass upwards from a part of the vein which is opposite to the third dorsal vertebra. Its extent is very different in different subjects. In some instances it passes so low as to supply the seventh or eighth intercostal space. This vein also gives off the *Left Bronchial Vein*, which sends branches to the œsophagus and bronchial glands.

The VERTEBRAL *Veins*

Arise from the subclavians, but sometimes they proceed differently in different subjects: the right passing behind, and the left before the subclavian artery of its respective side. Each of them, however, becomes contiguous to its corresponding artery. When it has arrived at the place in the transverse processes, where the artery enters the vertebral canal, it sends off an external branch, which passes up before, and nearly in contact with, those processes, and gives ramifications to the contiguous muscles,

and also to the cavity of the spine. These last mentioned ramifications enter by the lateral apertures between the transverse processes, and anastomose with the veins and sinuses of the cavity. The branch often finally terminates in the lateral sinus of the dura mater, by passing through the foramen near the mastoid process of the temporal bone. The *Main Trunk* of the vertebral vein generally sends off another external branch to the muscles near the basis of the neck, and afterwards enters the canal with the vertebral artery. While in this canal, it generally sends off two branches through each of the lateral apertures between the vertebræ. One of these branches passes backwards to the muscles of the neck, and the other proceeds into the great spinal cavity, and communicates with the venous sinuses.

When it has arrived at the atlas, the *Vertebral* vain sends branches to the contiguous muscles of the neck. It also frequently sends a branch through the posterior condyloid foramen of the occipital bone to the lateral sinus.

It is evident, from these circumstances, that the vertebral vein carries a portion of blood from the sinuses of the brain and of the spinal marrow, as well as from the muscles of the neck, into the subclavian veins.

The veins of the head are frequently very different in different subjects.

The INTERNAL JUGULAR,

Already mentioned, is often almost exclusively appropriated to the cavity of the cranium; and all the exterior veins of the head are ramifications of one or more smaller vessels, which pass up superficially on the neck, and are denominated *External Jugulars.* In some instances almost all the exterior veins of the head are united to the internal jugular at the upper

part of the neck, and it of course conveys the blood of the exterior as well as of the interior parts of the head. Frequently these veins are divided between the internal and external jugulars, but they are divided very differently in different subjects.

The *Internal Jugular*, however, almost always passes in the same direction from the inside of the origin of the sterno-mastoid muscle to the posterior foramen lacerum of the cranium. It is deeply seated on the external side of the common carotid artery, and under the sterno-mastoid muscle. Between the upper margin of the thyroid cartilage and the angle of the lower jaw, it often sends off branches which are very different in different subjects, but commonly pass to the anterior parts of the neck and face: above these it generally sends another to communicate with the external jugular. One of the branches which often go off from the internal jugular is that which corresponds with the superior thyroid or laryngeal artery. This vein, which has sometimes been called the *Guttural*, sends many ramifications to the thyroid gland. The *Ranular* veins, which are so conspicuous under the tongue, are also derived from it; and it likewise sends branches to the larynx and pharynx.

Before the internal jugular enters the foramen lacerum, it suffers a partial dilatation, which is generally larger on one side than the other.* This dilatation occupies the fossa at the foramen lacerum. After passing through the aforesaid foramen, the internal jugular terminates in the lateral sinuses of

* When the veins of the neck are injected, it very often appears that a considerable portion of the internal jugular is much larger on one side than the other, as if it were affected with varicose distention.

It also often appears that the general arrangement of the exterior vein is different on the two sides of the head and neck.

the dura mater.* These and the other sinuses within the cavity of the cranium are important portions of the venous system, which are interposed between the smaller branches spread upon the pia mater and the great trunks of the neck. They are described in the account of the brain, (Vol. I. page 324.) Into these sinuses the very numerous veins of the pia mater open, proceeding to the sinuses in a direction the reverse of that in which the blood flows in those channels.

These veins are divided very minutely on the pia mater before they enter the substance of the brain.

Into one of these sinuses, denominated the *Cavernous*, the ophthalmic vein discharges its contents. This vein proceeds from the anterior part of the sinus into the orbit of the eye through the sphenoid fissure.† Its ramifications correspond generally with those of the ophthalmic artery,‡ and some of them pass out of the orbit to anastomose with the branches of the facial vein.

The superficial veins of the neck are variously arranged in different persons. There is often one considerable vein,

The EXTERNAL JUGULAR,

Which is sent off by the subclavian, very near its union with the internal jugular; but sometimes it goes off from that vein much nearer the shoulder. There are sometimes two external jugulars, an ante-

* It is asserted that the internal coat, or lining membrane of the internal jugulars, is continued into the lateral sinuses, and extends throughout all the sinuses of the dura mater; so that the blood, during its passage through the sinuses, does not come in contact with any membrane different from that of the veins.

† See the account of this fissure in vol. i. p. 79.

‡ The Vasa Vorticosa of the choroides are one of the exceptions to this. See vol. i. p. 364.

rior and posterior, nearly of equal size. More frequently one of them is much smaller than the other. In a majority of cases, the principal external jugular goes off near the junction of the internal jugular and subclavian, as above stated, and proceeds upwards towards the angle of the lower jaw, passing between the platysma myoides and the sterno-mastoid muscle. It often sends off, at the basis of the neck, one or more branches to the contiguous muscles, and then proceeds upwards. Near the angle of the jaw, it often communicates with the internal jugular: it then continues upwards, covered with the parotid gland, near the temporal artery, and finally divides into superficial and deep-seated temporal branches.

The *External Jugular*, near the angle of the jaw, often sends off the facial vein, which crosses the basis of the lower jaw, near the facial artery, and distributes branches to the side of the face and to the forehead. It also very often sends off, near this place, the internal maxillary vein, which generally ramifies in such a manner that its branches correspond with those of the internal maxillary artery. Veins which correspond to some of the other branches of the external carotid artery, the lingual, occipital, &c., are often sent off near this place by the external jugular. They take the names of the arteries to which they correspond, and commonly accompany them.

The SUBCLAVIAN Vein,

Although it originates differently on the two sides of the neck, is situated alike on each of them. After parting with the internal jugular, it proceeds over the first rib, under the clavicle, and does not pass between the scaleni muscles, as is the case with the arteries, but before the anterior muscle. It soon joins the great artery of the arm, and proceeds before or below it to the axilla. In this situation, it gives off

branches to the contiguous parts, which correspond with those given off by the artery. In this course it also often gives off a large branch, called the

CEPHALIC,

Which soon becomes superficial, and proceeds downwards between the margins of the deltoid and pectoral muscles: it continues superficial on the external side of the biceps muscle, sending off many subcutaneous branches. Near the external condyle of the os humeri, it generally sends off a branch towards the middle of the anterior part of the fore-arm, which is called the *Median Cephalic*, and also some other superficial branches. It then continues over the radius, and inclining to the back of the fore-arm, until it arrives at the back of the hand, where it divides into branches, some of which go to the thumb.

In the axilla, the great vein, there called

The AXILLARY Vein,

Generally divides into two or three branches. One, which is commonly the largest, and appears like the continuation of the main trunk, is called

The BASILIC *Vein.*

This vessel passes down, deeply seated, to the bend of the elbow. It becomes superficial near the internal condyle, and divides into several branches.—One of these generally proceeds to join the median branch of the cephalic, and from the union of the two branches is formed the median vein, which passes down near the middle of the anterior part of the fore-arm. This vein generally sends off a branch which proceeds internally, and anastomoses with the deep-seated veins of the fore-arm.

There are frequently two other branches of the *basilic* vein. One, which is small, passes down on

the ulnar side of the anterior part of the fore-arm, but does not extend to the wrist. The other passes down on the ulna, and gradually proceeds to the back of the hand, when it divides into several branches, one of which is generally appropriated to the little finger.

The AXILLARY vein, after the *Basilic* leaves it, sometimes divides into two branches, and sometimes continues undivided. In either case it accompanies the humeral artery, and takes the name of HUMERAL *Vein* or *Veins*. It sends off branches which correspond to those of the artery, and continues to the bend of the elbow; here it is so divided, that two of its ramifications accompany each of the three arteries of the fore-arm. These ramifications sometimes communicate with each other by anastomosing branches near the elbow, and they communicate also with the superficial veins.

The superficial veins of the arm are so different in different subjects, that a general description will rarely apply accurately to an individual case. It may, however, be observed, that a Cephalic vein will generally be found, which very frequently arises from the subclavian instead of the axillary, and commonly continues to the hand on the radial side of the arm. The superficial veins, on the ulnar side of the fore-arm, very frequently are branches of a large vein which accompanies the humeral artery to the elbow, namely, the basilic; but the median vein, formed by branches of the cephalic and basilic veins, is very often not to be found.

SECTION II.

Of the INFERIOR VENA CAVA *and the Veins which are connected with it.*

THIS great vessel exceeds the Superior Cava in diameter. It proceeds from the lower part of the

right auricle, and very soon perforates the diaphragm, at a small distance in front of the spine, and rather to the right of the centre. As the pericardium adheres to the diaphragm at this place, the vessel appears to leave it abruptly. Immediately after leaving the diaphragm, it proceeds along a groove in the posterior edge of the liver, formed by the great lobe and the lobulus Spigelii.* After leaving the liver, it continues downwards, inclining backward and to the left, and is soon in contact with the aorta, which is on the left of it. It accompanies the aorta to its great bifurcation, and divides in the same manner. It sends off, during this course, branches to the Diaphragm, Liver, Right Renal Glands, the Kidneys, and the Testicles; and also the Lumbar and Middle Sacral Veins.

The Inferior Phrenic Veins

Are thus denominated to distinguish them from other veins, which are derived from the internal mammary, &c. They generally accompany the phrenic arteries, and are distributed in the same manner.

The HEPATIC *Veins*

Pass off from the vena cava, nearly at right angles, into the substance of the liver, while it is in the groove of that viscus, and before it has proceeded more than eight or ten lines from the heart.

They arise from the anterior part of the vena cava, and are generally three in number. Sometimes there are two only, but then one of them divides immediately after it enters the substance of the gland.

The distribution of these vessels in the liver has

* Sometimes it is completely surrounded by the liver.

been detailed in the account of that organ, and therefore need not be stated here; but the veins which unite to form the vena portarum, and the trunk of that great vein also, before it is connected with the liver, may be regarded as a portion of the regular venous system, and ought now to be considered.

The VENA PORTARUM

Passes downwards from the great sinus of the liver behind the pancreas, and inclining to the left. In this course it sends branches to the gall bladder, the stomach and pylorus, and the duodenum. At the upper and posterior edge of the pancreas, it sends off a very large branch to the spleen, which often passes, with slight meanders, along a groove in the pancreas.

The SPLENIC Vein

Often sends off the INFERIOR MESENTERIC vein, which proceeds downwards between the aorta and the left portion of the colon. It also sends off some of the coronary veins and the left gastro epiploic vein to the stomach; many small branches to the pancreas; and, finally, either from the main trunk or its branches, before they enter the spleen, the venæ breves, which pass to the great extremity of the stomach. Before it enters the spleen, it forms several ramifications, which accompany the branches of the splenic artery.

After sending off the splenic, the *Vena Portarum* takes the name of

The SUPERIOR MESENTERIC Vein,

Which is larger than the splenic, and passes *from behind the pancreas, before the transverse portion of the*

duodenum, into the mesentery; where it accompanies the superior mesenteric artery.

It is evident that the above described portion of the vena portarum simply performs the functions of a great vein; but when it takes on the arrangements for entering the liver, it no longer acts like a vein, but an artery.

The lower portion of the trunk of this vein and its ramifications is denominated *Vena Portæ Ventralis*. The part which ramifies in the liver, *Vena Portæ Hepatica*.

The Capsular Veins

Are small vessels, one on each side. That on the right passes from the vena cava to the right glandula renalis. That on the left arises from the left emulgent vein.

The EMULGENT, *or* RENAL *Veins*,

Are very large vessels, and, like the arteries, go off nearly at right angles, one to each kidney.

The right emulgent vein is not so long as the left, and it is rather anterior to its corresponding artery. The left emulgent, in its course to the kidney, crosses the aorta, and is anterior to it.

These veins pass to the sinus of each kidney, and ramify before they enter it. The ramifications follow those of the arteries.

The Spermatic Veins

Arise one on each side; the right from the vena cava, and the left from the emulgent vein. They proceed downwards behind the peritoneum, and on the psoas muscle generally divide into many branches, which communicate with each other as they progress downwards, and form a plexus denominated *Corpus Pampiniforme*. These branches proceed in the

spermatic cord to the back of the testis. The principal part enters the body of that gland; but some of the branches go to the epididymis. In females the spermatic vein, like the artery, passes to the ovary, the uterus and its appendages, &c.

The Lumbar Veins

Correspond to the arteries of the same name. They arise from the posterior and lateral parts of the inferior cava, and those on the left side pass under the aorta.

The Middle Sacral Vein

Resembles the artery of the same name in its origin and distribution.

The *INFERIOR VENA CAVA* accompanies the aorta to the space between the fourth and fifth lumbar vertebræ, and there it also divides into the two

PRIMITIVE ILIAC VEINS.

The left vein crosses behind the artery of the right side, and rather behind the left primitive iliac artery, which it accompanies until they are opposite to the junction of the sacrum and ilium, when it divides again, like the artery, into the internal and external iliac veins.

The INTERNAL ILIAC, or HYPOGASTRIC Vein

Descends into the pelvis behind the artery, which it accompanies. Its ramifications correspond in general with those of the artery, and, therefore, need not be particularly described.

The VENÆ VESICALES

Have such peculiarities that their ramifications require particular attention. They arise from the hy-

pogastric, very near the origin of the obturator, and are large, as well as numerous.

They are somewhat different in the two sexes. In men they form a remarkable plexus on the lateral and inferior portions of the bladder, and on the vesiculæ seminalis. This plexus extends more or less to the prostate: from it a number of veins proceed to the symphysis of the os pubis, which communicate in their course with the pudic vein. From thence arises the great vein of the penis, which proceeds in the groove between the corpora cavernosa, and terminates in the glans penis. This vein often divides, near the root of the penis, into two: one of which is in the groove, and the other more superficial.*

In females, the venæ vesicales form a considerable plexus on each side of the bladder and vagina. Many veins pass from these to the upper portions of the bladder and the contiguous parts, and form plexuses. The clitoris has a dorsal vein like the penis, and it originates in a manner analogous to the dorsal vein of the male.

The EXTERNAL ILIAC Vein.

The great trunk of the veins of the lower extremity proceeds on the inside of the artery, under the crural arch or Poupart's ligament. Before it passes from under the arch, it sends off two branches, which answer to the circumflex artery of the ilium and to the epigastric artery.

The Circumflex Vein

Arises from the external side of the iliac vein, and passes towards the anterior end of the spine of the

* The pudic veins accompany the arteries of that name. They communicate with the plexus, as above mentioned, and continue into the penis.

Ilium. It divides into branches, which accompany those of the artery of the same name.

The Epigastric Vein

Arises from the external iliac, and accompanies the epigastric artery. After passing a small distance inward and downward, it turns up on the inside of the abdominal muscles. In the first part of its course it sends off some small branches to the spermatic cord.

After passing beyond Poupart's ligament, the name of the great vessel is changed from external iliac to

FEMORAL VEIN.

It proceeds downwards at first on the inside of the femoral artery, but gradually changes its relative situation, so that, in the thigh and in the ham, it is behind or on the outside of that vessel.

At a short distance below Poupart's ligament, after giving off some small branches to the external organs of generation, and to the glands of the groin, it sends off, on the internal side of the thigh, a very large vein, which is called the

SAPHENA MAJOR.

This vein immediately becomes superficial, and passes down on the internal side of the thigh, somewhat anteriorly; giving off some small branches to the contiguous parts soon after it originates; and many superficial veins afterwards. It continues along the inside of the knee and leg to the internal ankle, the anterior part of which it passes over. It then proceeds along the internal part of the upper surface of the foot to the middle, when it curves towards the external edge, and joins the lesser saphena. On the

leg and foot, it also sends off many branches, which anastomose with each other, and with those of the aforesaid vein.

The *femoral* vein, after parting with the saphena, soon sends off the vena profunda, and the circumflexa also, when they do not arise from the profunda. These veins are generally larger than the arteries to which they correspond, and their branches are more numerous; but they observe the same course.

The great vein accompanies the artery down the thigh, and through the perforation in the biceps; but it changes its relative position, so that it is placed behind or on the exterior side of the artery, at the lower part of the thigh. It is very often behind it in the ham, where, like the artery, it takes the name of POPLITEAL. In the ham it sends off another superficial vein, which seems very analogous to the basilar vein of the arm. This is called

The Lesser or External Saphena.

It proceeds from the ham over the external head of the gastrocnemius, and down the outside of the leg, sending off many branches in its course. It passes behind the external ankle, and near the exterior edge of the upper surface of the foot, about the middle of which it inclines towards the great saphena, and forms with it the anastomosis already mentioned.

The popliteal vein, after passing across the articulation, ramifies like the artery, but sends two veins, which accompany each of the three arteries of the leg.

In a few instances, some of the larger veins have been found to be arranged in a manner very different from that which is commonly observed.

One case of this kind has already been mentioned in the account of the liver,* where the *Vena Portarum* terminated in the *Vena Cava*, below the liver, without entering into it.

Another very remarkable instance of peculiar arrangement is to be seen in a preparation now in the University of Pennsylvania, in which the *Inferior Cava*, instead of opening into the lower part of the right auricle, passes behind it, in the tract of the *Vena Azygos*, and opens into the *Superior Cava*, in the place where the *Vena Azygos* usually communicates with that vessel, receiving the *Intercostal Veins* in its course.

In this preparation, the *Hepatic Veins* communicate directly with the right auricle, at its lower part; the *middle* and *left* hepatic veins forming one trunk before they enter, and the *right* vein passing in singly.†

Of the PULMONARY Arteries and Veins.

Those portions of the *Pulmonary* artery and veins which are distinct from the lungs may be described very briefly.

It has been already observed,‡ that the pulmonary artery arises from the left and most anterior part of

* See note to p. 132, of this volume.

† The foregoing preparation was made by the present editor in 1814, since which two other anomalous cases have occurred to him.

1819. Case 1st. The ascending cava passed into the thorax on the left side of the spine, and getting as far as its upper part, was joined there by the trunk of the internal jugular and subclavian of the left side. It there passed across the vessels of the arch of the aorta and joined with the descending cava. The vessels of the liver entered the heart at the usual place, in the lower part of the right auricle.

1820. Case 2d. The trunk formed by the junction of the internal jugular and subclavian of the left side, instead of taking its usual course, passed down vertically, before the left branch of the pulmonary artery and before the left auricle, then making a slight curve between this auricle and the diaphragm joined with the ascending cava.—Ed.

‡ See page 59 of this volume.

the basis of the right ventricle, and proceeds thence obliquely backwards, inclining gradually to the left side for about eighteen or twenty lines, when it divides into two branches, which pass to the two lungs. This course places it under the curve of the aorta: for that great vessel passes over the right branch of the pulmonary artery, and the right side of the main trunk of it, in such a manner that it proceeds downwards between the two branches, and behind the angle formed by their bifurcation. From this place of bifurcation a short ligament proceeds to the lower part of the curve of the aorta, which is almost in contact with it. This ligament was originally the canal that formed the communication between the pulmonary artery and the aorta of the fœtus. Each of the great branches of the pulmonary artery takes a direction backwards, and to its respective side. It soon joins the corresponding branch of the trachea and the two pulmonary veins, being anterior to the branch of the trachea, and above the pulmonary veins. It is also invested, in common with them, by that portion of the pleura which forms the mediastinum, and thus enters into the composition of the root of the lungs.

The *Pulmonary Veins* are four in number—two on each side. In conformity to the mode of description which we have adopted, it may be said that they arise from the sides of the *Left Auricle,* and proceed nearly in a transverse direction, two of them to each lung; where they accompany the branches of the artery and of the trachea, being invested by the mediastinum, in common with these branches. It has been observed that they differ from veins in general, by preserving a diameter nearly similar to that of the arteries which they accompany.

SYSTEM OF ANATOMY.

PART X.

OF THE NERVES.

The nerves are those whitish cords which pass from the brain and spinal marrow to the various parts of the body.

A general account of their origin is contained in the description of the basis of the brain and of the spinal marrow,* which may be considered as introductory to the present subject.

The nerves, in general, appear to be bundles or fasciculi of small cords, each of which is composed of a series of fibres that are still smaller. These fibres consist of medullary matter, which is derived from the brain and spinal marrow, and is enclosed in a membranous sheath that appears to arise from the pia mater. The smaller the fibre, the more delicate is the membrane which invests it.

As the nerves proceed from the brain and spinal marrow, through the foramina of the cranium and the spine, they are enclosed in a sheath formed by the dura mater; but when they arrive at the exterior extremities of the foramina in those bones, this coat, derived from the dura mater, appears to separate into two lamina. The exterior lamen combines with the periosteum, and the interior continues to invest

* See volume I. page 349.

the nerve, but seems to change immediately into cellular substance; so that the exterior coat of the nerves may be regarded as composed of cellular membrane, which is continued from the sheath derived from the dura mater.

It has been supposed that the membrane which forms the sheaths for the medullary fibrils of which the nerves are composed, is of a peculiar nature; but it appears to be derived from the pia mater, investing the brain and the spinal marrow. It is very vascular.*

The ramification of a nerve is simply the separation of some fibres from the general fasciculus. The branch commonly forms an acute angle with the main trunk.

The course of these branches from their origin to their termination is generally as straight as possible.

When the nervous cords are examined in an animal recently dead, there is an appearance of white lines arranged in a transverse or spiral direction. The cause of this appearance is not well understood.

In various parts of the body net works are formed by the combination of different nerves or the branches of nerves. In those instances the branches of one nerve unite with those of another, and form new branches. These new branches again divide, and their ramifications unite with other new ramifications to form other new trunks. These new trunks divide again, and form new combinations in the same way.

The trunks last formed proceed to the different

* Several authors have written professedly on the structure of the nerves, viz, Monro, in his "Observations on the Structure and Functions of the Nervous System."—Bichat, "Anatomie Generale."—Fontana, "Treatise on the Poison of the Viper."—Reil, "Exercitationes Anatomicæ."—Scarpa, "Annotationes Academicæ."—Prochaska, "De Structura Nervorum."

I regret that it has not been in my power to procure Reil, Prochaska, or Scarpa.

parts of the body, as other nerves do which arise immediately from the brain.

These combinations are denominated *Plexuses.* There are several of them in the cavities of the abdomen and thorax, formed by the ramifications of the par vagum and the sympathetic nerves. The four lower cervical, and the first dorsal nerve, form a very remarkable plexus of this kind, which extends from the side of the neck to the axilla, and forms the nerves of the arm. The lumbar nerves form a similar plexus, although not so complex, from which the crural nerve arises. The anterior nerves of the sacrum also unite for the formation of the great sciatic nerve.

It appears to be clearly ascertained, that the great object of this peculiar arrangement is the combination of nervous fibres from many different sources, in each of the nerves, which are distributed to any organ. Thus, the smaller nerves of the arm, that are distributed to the different parts, are not to be regarded simply as branches of any one of the five nerves which are appropriated to the upper extremity, but as composed of fibres which are derived from each of them.

Many of the nerves are enlarged in particular places, so as to form small circumscribed tumours, which are denominated *Ganglions.*

These *Ganglions* are generally of a reddish colour. By very dexterous management, they can be shown to consist of a texture of fibres. The larger cords, which compose the nerve, seem suddenly to be resolved into the small fibres, of which they consist. These small fibres, after proceeding separately a greater or lesser distance, according to the size of the ganglion, and changing their relative situation, are again combined in cords, which recompose the nerve.

These fibres appear to be surrounded by a fine

cellular substance, which is vascular, moist, and soft. It is asserted that, in fat subjects, an oily substance, resembling fat; and in hydropic subjects, a serous fluid has been found in this texture.

Ganglions are often connected with but one nerve, which seems to enter at one extremity and go out at the other. But they frequently receive additional branches from other nerves, and send off additional branches to parts different from those to which their principal nerves are directed. When connected with but one nerve, they have been called *simple ganglions:* when they receive and give off additional branches, they are denominated *compound ganglions.* It does not appear that there is any important difference in their structure, in these cases.

The simple ganglions occur in the nerves of the spinal marrow—the posterior fasciculus of the nerves having always formed a ganglion before it is joined to the anterior fasciculus. The sympathetic nerve, throughout its whole extent, forms compound ganglions.

The use of this particular structure does not appear to be perfectly known. It seems, however, certain, that the different fibres—(of which the nerves forming ganglions are composed)—are blended together and arranged in a manner different from that in which they were arranged before the nerve entered the ganglion.

It ought to be observed, that the combination of nervous fibrillæ, so as to bring together those fibrils which originally belonged to different cords, seems to have been kept in view throughout the whole arrangement of the nervous system. It is not only in the plexus and the ganglion that this appears, but, also, in some of the larger nerves; for in them, the fibres which form the cords that compose the nerve, instead of running parallel to each other, along the

whole extent of the nerve, form a species of plexus in their course, separating from the fibres with which they were originally combined, and uniting with the fibres of other cords; as in other cases of plexus.*

There have been doubts respecting the possibility of a reproduction of the substance of the nerves when it has been destroyed; but it appears to have been clearly proved by the experiments of Mr. Haighton, that a reproduction does really take place.†

Nine pair of nerves proceed from the brain through the foramina of the cranium. They are called *Nerves of the Brain*, or *Cerebral Nerves*. One pair passes off between the cranium and the spine, which is called *Sub-Occipital*. Twenty-nine or thirty pair pass through the foramina of the spine: they are denominated *Cervical*, *Dorsal*, *Lumbar*, and *Sacral*, from the bones with which they are respectively connected. There are seven pair of Cervical nerves, twelve Dorsal, five Lumbar, and five or six Sacral—amounting, with the nerves of the brain, to thirty-nine or forty pair.

NERVES OF THE BRAIN.

The nerves which go off from the brain and medulla oblongata are named numerically, according to the order in which they occur, beginning with the anterior. They also have other names, which generally are expressive of the functions of the different parts to which they are distributed.

Those which go to the nose are anterior to all the others, and are, therefore, denominated

THE FIRST PAIR, OR THE OLFACTORY NERVES.

They arise by three delicate white fibres from the

* See Monro's Observations on the Structure and Functions of the Nervous System. Plate xviii.

† See London Philosophical Transactions, for 1795, Part I.

under and posterior part of the anterior lobes of the brain, being derived from the *Corpora Striata*. They proceed forward to the depression on the cribriform plate of the ethmoid bone, on each side of the crista galli. The upper surface occupies a small sulcus formed by the convolutions of the lower surface of the brain, and, therefore, has a longitudinal ridge on it. The lower surface is flat. Their texture is like that of the medullary part of the brain.

On each side of the crista galli each of them forms a pulpy enlargement of a brownish colour, which is called the *bulb*, and has been considered as a ganglion.

From this bulb many fine and delicate cords go off, which proceed through the dura mater and the foramina of the cribriform plate to the Schneiderian membrane.—These ramifications of the olfactory nerve seem to receive a coat from the dura mater, as they are much more firm after they have passed through it. They appear to be arranged in two rows as they proceed from the ethmoid bone—one running near to the septum, and the other to the opposite surface of the ethmoid bone.*

THE SECOND PAIR, OR THE OPTIC NERVES,

Originate from the *Thalami Nervorum Opticorum*, and appear on the external and lower surface of the brain, on each side of the sella turcica.

Each of them seems like a cord of medullary matter enclosed in a coat derived from the pia mater, and has not the fasciculated appearance of the other nerves. The medullary matter, however, appears to be divided by processes that pass through it, which are derived from the coat of the nerve.

* See Vol. II. p. 6.

They proceed obliquely forward and inward, on each side of the sella turcica, in contact with the brownish cineritious substance, in which the infundibulum and the corpora albicantia of Willis are situated.* Anterior to this substance they come in contact with each other, and again separate, in such a way, that it is an undecided question whether they decussate each other, or whether each forms an angle, and is in contact with the other at the angle.

From this place of contact, each nerve proceeds to its respective foramen opticum, where it receives a coat from the dura mater, which extends with it to the eye, as has been described in the account of that organ.

THE THIRD PAIR OF NERVES

Are sometimes called *Motores Oculorum*, in consequence of their distribution to several muscles of the eye. They arise at the inside of the crura cerebri, and make their appearance on the basis of the brain, at the interior part of the pons Varolii.

They originate by numerous threads, which soon unite so as to form a cord, which passes through the dura mater, on each side of the posterior clinoid process, and continues through the cavernous sinus, and the foramen lacerum, to the orbit of the eye.

Before this nerve enters the orbit it generally divides into two branches which are situated one above the other. The *Uppermost Branch* is spent principally upon the rectus superior muscle of the eye, but sends a twig to the levator palpebræ. The *Inferior Branch* is distributed to two of the recti muscles, viz. the internus and the inferior, and also to the inferior oblique. It likewise sends a twig to a small ganglion in the orbit, called the *Lenticular* or *Oph-*

* See Vol. I. page 381.

*thalmic Ganglion,** from which proceed the fine nervous fibres that perforate the sclerotic coat.†

THE FOURTH PAIR OF NERVES

Are called *the Pathetic,* in consequence of the expression of the countenance produced by the action of the muscle on which they are spent. They arise from the side of the valve of the brain, below and behind the Tubercula Quadrigemina,‡ and are so small that they appear like sewing thread. They proceed round the crura of the cerebrum, and appear on the surface between the pons Varolii and the middle lobes of the brain. They proceed along the edge of the tentorium, which they perforate, and passing through the upper part of the cavernous sinus, enter the orbit by the foramina lacera. They are exclusively appropriated to the *Superior Oblique,* or *Trochlearis* muscle.

THE FIFTH PAIR OF NERVES

Are called *Trigemina,* because each nerve divides into three great branches.

These nerves arise from the crura of the cerebellum, where they unite to the pons Varolii by distinct fibres, which are connected so as to form a cord or nerve, that is larger than any other nerve of the brain. In many subjects this cord seems partially divided into two portions, the anterior of which is much smaller than the posterior, and appears softer at its origin.

It passes into a short canal formed by the dura mater, near the anterior extremity of the petrous por-

* This ganglion, which is considered as the smallest in the body, lies on the outside of the optic nerve, near its entrance into the orbit, and is generally surrounded by soft adipose matter.

† See Vol. I., page 364.

‡ See Vol. I., page 343.

tion of the temporal bone, at a small distance below the edge of the tentorium. It is perfectly loose and free from adhesion to the surface of this canal; but it soon passes out of it under the dura mater, and then adheres to that membrane. After leaving the canal, it expands like a fan, but still consists of fine fibres, which have some firmness. It is said that there are seventy or eighty of these fibres in the expansion, but they appear to be more numerous. Round the circumference of the expansion is a substance of a brownish colour, into which the fibres enter. This is the *Semilunar Ganglion*, or the *Ganglion of Gasser*, and from it the three nerves go off.

These nerves pass off from the convex side of the ganglion, and are denominated the *Ophthalmic*, the *Superior Maxillary*, and the *Inferior Maxillary*.

The Ophthalmic Nerve

Passes into the orbit of the eye through the foramen lacerum: it there divides into several branches, which are called, from their distribution, *the Frontal* or *Supra Orbitar*, *the Nasal* and *the Lachrymal.*

The *Frontal* or *Supra Orbitar* branch proceeds forward in the upper part of the orbit, exterior to the membrane which lines it, and divides into two ramifications. One of these is small, and passes out of the orbit near the pulley of the superior oblique, to be spent upon the orbicularis muscle and the contiguous parts.

The other ramification passes through the Supra Orbitary Foramen, or through the notch, which is in the place of that foramen, and divides into a number of twigs, some of which pass transversely towards the side of the head, and communicate with twigs from the portio dura. Most of the others extend up-

wards on the head. Some are distributed to the anterior part of the occipito-frontalis muscle, and the integuments of the forehead; others are spent upon the upper portion of the scalp. Some of the extreme parts of these ramifications also communicate with the portio dura.

The *Nasal Branch* proceeds obliquely forward towards the inner side of the orbit, and sends a twig, in its course, to the lenticular ganglion. It also sends off some small twigs, to join the ciliary nerves which go from the ganglion. On the inside of the orbit, a branch leaves it, which proceeds through the *Foramen Orbitare Internum Anterius* to the cavity of the cranium, and passes a small distance upon the cribriform plate of the ethmoid bone, under the dura mater, to a fissure in the said plate near the crista galli, through which it proceeds into the cavity of the nose. Here it divides into twigs, some of which pass on the septum near its anterior edge, and terminate on the integuments at the end of the nose, while others pass down on the inferior turbinated bone.

After parting with the ramifications to the nose, the remainder of the nasal branch continues to the internal canthus of the eye, and sends twigs to the lachrymal sac, the caruncula lachrymalis, the eyelids, and the exterior surface of the upper part of the nose.

The *Lachrymal Branch* proceeds obliquely forward and outwards, towards the lachrymal gland. In its course, it sends off a twig, which passes through the spheno maxillary fissure, and communicates with a twig of the upper maxillary nerve, and one or more twigs that pass to foramina in the malar bone. The main branch passes to the lachrymal gland, and some twigs continue beyond it to the contiguous parts.

The Superior Maxillary Nerve.

The second branch of the fifth pair is examined with great difficulty on account of its peculiar situation. It proceeds from the semilunar ganglion, and passes through the foramen rotundum of the sphenoid bone into the upper part of the zygomatic fossa. In this situation it sends a twig to the orbit by the spheno maxillary fissure, and a branch, called the *Infra Orbitar*, which appears like the main nerve, as it preserves a similar direction, to the infra orbitar canal. At the same place it sends downwards two branches, which unite together almost immediately after their origin, and, as soon as they have united, enlarge into a ganglion.* This ganglion is called the *Spheno Palatine*. It is rather of a triangular figure, and lies very near the spheno palatine foramen. It gives off a posterior branch, which passes through the pterygoid foramen to the cavity of the cranium: some branches which proceed through the spheno-palatine foramen to the nose, and are called the *Spheno Palatine* or *Lateral Nasal Nerves:* and an inferior branch that proceeds through the posterior palatine canal, and is called the *Palatine Nerve*.

The small branch, which was *first* mentioned, as going to the orbit by the spheno maxillary fissure, divides into two ramifications. One of them unites with a twig of the lachrymal branch above mentioned, and passes out of the orbit, through a foramen in the malar bone, to the face, where it is distributed. The other passes also through a foramen of the malar bone, into the temporal fossa, and, after uniting with twigs from the *Inferior Maxillary Nerve*, proceeds backwards and perforates the aponeurosis of

* Sometimes a single branch passes downwards instead of two; but it forms a ganglion in the same place.

the temporal muscle, to terminate on the integuments of the temporal region.

Before the *Infra Orbitar* branch enters the canal of that name, it sends off two twigs called *Posterior Dental Nerves,* which pass downwards on the tuberosity of the upper maxillary bone, and enter into small canals in that bone, that are situated behind the Antrum Maxillare. They subdivide into fine twigs that proceed forward to the alveoli of three or four of the last molar teeth, and penetrate each of the roots by a cavity at its extremity. Twigs also proceed from these nerves to the posterior part of the gums and buccinator muscle.

After the posterior dental nerves have left it, the *Infra Orbitar* nerve proceeds forwards in the canal of that name; and near the extremity of it, gives off the anterior dental nerve, which accompanies it for some distance, and then proceeds downwards in a canal in the bone anterior to the antrum maxillare. In its course this nerve divides into many fibres, which pass to the roots of the incisor, canine, and small molar teeth, each in its proper canal. These dental branches sometimes pass in the antrum maxillare between the lining membrane and the bones. The *Infra Orbitar* nerve passes out of the foramen upon the cheek, and divides into several branches of considerable size, which are distributed on the face from the side of the nose to the back of the cheek, and also upon the under eye-lid and the upper lip.

The *Pterygoid Nerve,* or posterior branch, passes backwards, from the ganglion to a canal in the base of the pterygoid process of the Os Sphenoides, and proceeds through it. After leaving this canal, it passes through a substance almost as firm as cartilage, which closes the anterior foramen lacerum, at the basis of the cranium, and divides into two branches. The smallest of them, called the *Vidian*

Nerve, proceeds with a small artery to the small foramen, or Hiatus Fallopii, on the anterior side of the petrous portion of the temporal bone, and continues, through a small canal, to join the Portio Dura of the seventh pair in the larger canal, called the *Aqueduct of Fallopius,* at the first turn in that canal.* The other branch of the pterygoid nerve proceeds to the Foramen Caroticum, and passes through it, with a twig of the sixth pair, to join the first cervical ganglion of the *Intercostal Nerve.*

The *Spheno-Palatine, or Lateral Nasal Nerves,* consist of several branches which pass from the spheno palatine ganglion through the Spheno palatine foramen into the nose. Some of them are distributed to that part of the pituitary membrane, which is above the upper meatus, and others to the part which is immediately below it. Some of the branches which thus enter the nose are spread upon the septum; one among them extends upon it, downwards and forwards, to the anterior part of the palatine process of the upper maxillary bone, where it enters into the foramen incisivum, and terminates in a papilla in the roof of the mouth.†

The *Palatine Branch* proceeds through the canal formed by the upper maxillary and palate bones, to the roof of the mouth and the soft palate. Soon after its origin, it sends off a twig which proceeds down a small canal that is behind it. It also sends off, as it proceeds downwards, several twigs to that part of the membrane of the nose which covers the

* The late Mr. John Hunter believed that this nerve parts from the portio dura at the lower end of the aqueduct, and is the chorda tympani.

† The curious distribution of this nerve appears to have been known to the late John Hunter, and also to Cotunnius; but it is minutely described by Scarpa, and is delineated by Soemmering in his plate of the nose.—See "Observations on certain parts of the Animal Economy," by J. Hunter, page 219, and also Scarpa "De Organo Olfactus." In this last are some interesting observations relative to the ducts of Steno.

inferior turbinated bone. When it arrives at the roof of the mouth, it divides into several branches which run forwards, and are distributed to the membrane which lines the roof of the mouth. Some of its branches pass to the soft palate, the uvula, and the tonsils; small filaments pass into the back part of the upper jaw.

The inferior Maxillary Nerve, or the Third Branch of the Fifth Pair,

Passes through the foramen ovale into the zygomatic fossa, and divides into *two branches*, one of which sends ramifications to many of the contiguous muscles, as the Temporal, the Masseter, the Buccinator, the Pterygoid; and, also, to the anterior part of the ear and the side of the head. The other branch passes between the pterygoid muscles, and divides into two ramifications, one of which proceeds to the tongue, and is called the *Lingual* or *Gustatory*, while the other passes into the canal of the lower jaw.

The *Lingual Nerve* proceeds between the pterygoid muscles, and, in its course, is joined by the chorda tympani. It continues forward between the maxillary gland and the lining membrane of the mouth; and passes near the excretory duct of that gland, above the mylo-hyoideus and the sublingual gland to the under side of the tongue, near the point: it then divides into a number of branches which enter into that body between the genio-hyoideus and lingualis muscles. This nerve has been supposed to be particularly concerned in the function of taste, because many of its branches continue to the upper surface of the tongue, especially near the point. In its course it has a communication with the ninth pair of nerves, and it sends twigs to the

membrane of the mouth and gums, and the contiguous parts.

After parting with the lingual nerve, the inferior maxillary continues to the upper and posterior orifice of the canal in the lower jaw. Before it enters this canal it sends a branch to the sub-maxillary gland, and to the muscles under the jaw. It then enters the canal, attended by blood vessels, and proceeds along it to the anterior maxillary foramen, on the side of the chin, through which it passes out. In this course it sends twigs to the sockets of the teeth, and generally supplies all the large and one of the small grinders. Before it leaves the jaw it sends a branch forward, which supplies the remaining teeth on the side to which it belongs. After passing out, through the anterior foramen, it is spent upon the muscles and integuments of the front of the cheek, the chin and the under lip.

THE SIXTH PAIR OF NERVES

Are called *Motores Externi*. They arise from the commencement of the medulla oblongata, and proceed forward under the pons Varolii. They proceed through the dura mater on the inside of the fifth pair, and appear to pass through the cavernous sinuses, but are enclosed in sheaths of cellular membrane while they are in those sinuses. When in this situation they are near the carotid arteries, and each nerve sends off one or more very fine twigs, which being joined by a twig from the pterygoid branch of the fifth pair, accompany the carotid artery through the carotid canal, and then unite themselves to the upper extremity of the upper cervical ganglion of the intercostal nerve.

The sixth pair afterwards pass into the orbit of the eye, each through the foramen lacerum of its respec-

tive side, and is spent upon the *Rectus Externus* or *Abductor* muscle of the eye.

THE SEVENTH PAIR OF NERVES

Comprises two distinct cords, which have very different destinations; and have, therefore, been considered as different nerves, by several anatomists. One of these cords is appropriated to the interior of the ear, and is the proper *Auditory Nerve*. The other is principally spent upon the face, and, therefore, has been called the *Facial*. They have, however, more frequently been denominated the *Seventh Pair*, and distinguished from each other, in consequence of a great difference in their texture, by the appellations of *Portio Dura* and *Portio Mollis*.

These two cords pass off nearly in contact with each other, from the side of the upper part of the *Medulla Oblongata*, where it is in contact with the pons Varolii; but the *Portio Mollis* can be traced to the fourth ventricle, while the *Portio Dura* is seen to rise from the union of the pons Varolii with the medulla oblongata and the crura Cerebelli. The *Portio Dura*, at its origin, is on the inside of the *Portio Mollis*. Between these cords are one or more small fibres, called *Portio Media*, which seem to originate very near them, and finally unite with the *Portio Dura*.

Each of the seventh pair of nerves, thus composed, proceeds from its origin to the Meatus Auditorius Internus of the temporal bone; and the Portio Mollis divides into fasciculi, which proceed to the different parts of the organ of hearing in the manner described in the account of the ear.*

The *Portio Dura* enters an orifice at the upper and anterior part of the end or bottom of the *Meatus*

* See Vol. I. p. 344.

Auditorius Internus. This orifice is the commencement of a canal, which has been called the *Aqueduct of Fallopius,* and proceeds from the *Meatus Auditorius Internus* to the external foramen, between the mastoid and styloid processes at the basis of the cranium. This canal first curves backwards and outwards, near to the upper surface of the petrous bone, then forms an acute angle, and proceeds, (backwards and downwards,) to the stylo-mastoid foramen, passing very near the cavity of the tympanum in its course.

The *Portio Dura,* as it passes into the canal from the meatus internus, seems to receive an investment from the dura mater. It fills up the canal, but does not appear to be compressed. Near the angle it is joined by the twig of the Vidian nerve, which proceeds from the pterygoid branch of the fifth pair, and enters the petrous bone by the small foramen innominatum on its anterior surface. In its course through the canal it sends off some very small twigs to the muscles and appurtenances of the small bones of the ear, and to the mastoid cells; and, when it has arrived almost at the end of the canal, it sends off, in a retrograde direction, a small branch which proceeds into the cavity of the tympanum, (entering it by a foramen near the base of the pyramid,) and crosses the upper part of it, near the membrana tympani, between the long processes of the *Malleus* and *Incus.* This twig is the *Chorda Tympani;* it proceeds from the cavity by a fissure on the outside of the Eustachian tube, to join the lingual branch of the fifth pair, as has been already mentioned.*

The *Portio Dura,* after passing out of the *Fora-*

* The late John Hunter believed that the chorda tympani is merely a continuation of the twig of the pterygoid branch which joins the portio dura above.—See Observations on certain parts of the Animal Economy, page 220.

men Stylo-Mastoideum, is situated behind and within the parotid gland. Here it gives small twigs to the back of the ear and head, and to the digastric and stylo-hyoideus muscles. It perforates the gland after sending filaments to it, and then divides into branches which are arranged in such a manner that they constitute what has been called the *Pes Anserinus*.

To describe the various branches in this expansion would be more laborious than useful. Some of them are spread upon the temple and the upper part of the side of the head, and unite with the supra-orbitar branches of the ophthalmic nerve. Some pass above and below the eye, and are distributed to the orbicularis muscle, and communicate with nervous twigs that pass through foramina in the malar bone, &c. Some large branches pass transversely. They cross the masseter muscle, and divide into ramifications which are spent upon the cheek and the side of the nose and lips, and communicate with the small branches of the superior maxillary nerve.

A large number of branches pass downwards. Many of them incline forwards, and are spent on the soft parts about the under jaw; while others proceed below the jaw to the superficial muscles and integuments of the upper part of the neck, communicating with the branches of the contiguous nerves.*

THE EIGHTH PAIR OF NERVES

Are very frequently denominated the *Par Vagum*, on account of their very extensive distribution.

* A most minute and laboured description of the nerves of the face was published by the celebrated Meckel, in the seventh volume of Memoirs of the Royal Academy of Sciences of Berlin, for the year 1751, accompanied with a plate, exhibiting the side of the head, of three times the natural size. This is republished in the Collection Academique: Partie Etrangére.—Tom. viii.

They arise from those portions of the medulla oblongata which are denominated the *Corpora Olivaria.* Each nerve consists of a cord, which is anterior, and called the *Glosso-Pharyngeal;* and of a considerable number of small filaments, which arise separately, but unite and form another cord, the proper *Par Vagum.* Associated with these is a third cord, called the *Spinal,* or *Accessory Nerve* of Willis, which originates in the great canal of the spine, and, passing up into the cavity of the cranium, goes out of it with these nerves through the foramen lacerum.

The two first mentioned nerves proceed from their origin to the posterior foramen lacerum, and pass through it with the *Internal Jugular* vein,—being separated from the vein by a small process of bone. They are also separated from each other by a small process of the dura mater. In the foramen they are very close to each other; but soon after they have passed through it, they separate and proceed towards their different destinations.

The *Glosso-Pharyngeal* proceeds towards the tongue, between the stylo-pharyngeus and the stylo-glossus muscles, following the course of the last mentioned muscle to the posterior part of the tongue. At the commencement of its course it receives a twig from the *Portio Dura,* and one also from the *Par Vagum.* It soon gives off a branch which passes down on the inside of the common carotid to the lower part of the neck, where it joins some twigs of the intercostal to form the cardiac nerves. Afterwards it sends off several twigs to the muscles of the pharynx and its internal membrane, and also some twigs which unite with others from the upper cervical ganglion of the *Sympathetic,* and form a network that lies over the anterior branches of the external carotid. The *Glosso-Pharyngeal* finally enters the tongue, at the termina-

tion of the hyo-glossus muscle; and after sending branches to the lingualis, and the various muscles inserted into the tongue, terminates in small ramifications that are spent upon the sides and middle of the root of the tongue, and upon the large papillæ.

THE PAR VAGUM

Are slightly enlarged after passing through the foramen lacerum. As they descend, they adhere to the superior ganglion of the intercostal, and also to the ninth pair. They proceed behind and on the outside of the carotid, and are contained in the same sheath of cellular membrane which encloses that artery and the internal jugular vein. Each of these nerves, soon after it leaves the cranium, gives a twig to the glosso-pharyngeal; that soon after it sends off a branch called the *Pharyngeal,* which unites to one from the accessory nerve, and to one or more from the glosso-pharyngeal, and proceeds to the middle constrictor of the pharynx, when it expands into ramifications that form a plexus from which proceed a number of small twigs that go to the larynx, and some that pass down on the common carotid artery.

It then sends off, downward and forward, the *Superior Laryngeal* nerve, which continues in that direction behind the carotid artery, and divides into an external and internal branch.

The *Internal Branch,* which is the largest, proceeds between the os hyoides and the thyroid cartilage; and divides into numerous ramifications which are distributed to the arytenoid muscles and to the membrane which lines the larynx and covers the epiglottis. It is said, that fine twigs can be traced into the foramina, which are to be seen in the cartilage of the epiglottis;—some ramifications can be traced to the pharynx;—others communicate with the branches of the recurrent nerve.

The *External Branch* sends twigs to the pharynx, to the lower and inner part of the larynx, and to the thyroid gland.

In its course downwards, the great nerve sometimes sends off a twig, which unites with one from the ninth pair that passes to the sterno-hyoidei and sterno-thyroidei muscles.

It uniformly sends off one or more twigs, which pass into the thorax and combine with small branches from the sympathetic or intercostal nerve, to form the *Cordiac plexus*, which sends nerves to the heart.

After entering the thorax, the right trunk of the *Par Vagum* passes before the subclavian artery; and the left trunk before the arch of the aorta; and immediately after passing these arteries, each of the nerves divides into an anterior and posterior branch. The anterior is the continuation of the *Par Vagum;* the posterior is a nerve of the *Larynx;* which, from its retrograde course, is called the *Recurrent Nerve.*

On the left side the *Recurrent Nerve* winds backwards round the aorta, and, on the right side, round the subclavian artery, and proceeds upwards, deeply seated, on the side of the trachea, to the *Larynx.* Soon after its origin it sends filaments to a ganglion of the sympathetic, to the cardiac plexus, and to a pulmonary plexus, soon to be mentioned. In its course upwards, it sends twigs to the trachea and the œsophagus. It proceeds behind the thyroid gland, and sends twigs to that organ. At the lower part of the larynx it sends off a branch which communicates with branches of the superior laryngeal nerve. It also divides into branches which are spread upon the posterior crico-arytenoid, and the arytenoid muscles; and also upon the lateral crico-arytenoid and the thyreo-arytenoid muscles, as well as upon the mem-

brane which lines the back part of the larynx and the contiguous surface of the pharynx.

There is a difference in the arrangement of the recurrents on the different sides, in consequence of one winding round the aorta, while the other winds round the subclavian artery.

After sending off the recurrents, each trunk of the *Par Vagum* proceeds behind the ramifications of the trachea; but previously detaches some small branches, which are joined by twigs from the intercostal and from the recurrent, and form a plexus upon the anterior part of the vessels going to the lungs. This *Anterior plexus*, after sending off some minute branches to the cardiac nerves and the pericardium, transmits its branches with the bronchia and the blood vessels, into the substance of the lungs.

Some of the branches which proceed from the par vagum, pass down on the posterior part of the trachea, and enter into the membrane which forms it, and the mucous glands which are upon it; and some pass to the œsophagus.

When the par vagum is behind the great vessels of the lungs, a number of branches go off transversely, and are also joined by some fibres from the sympathetic. These form the *Posterior pulmonary plexus*; the ramifications from which proceed into the substance of the lungs, and are principally spent upon the ramifications of the bronchia. It has been said,* that the small twigs into which they divide, very generally penetrate into the small ramifications of the bronchia, and are spent upon their internal membrane.

Soon after sending off the nerves of the pulmonary plexus, the *Par Vagum* proceeds downwards

* See Buisson, in the continuation of the Descriptive Anatomy of Bichat.

upon the œsopagus; the left nerve being situated anteriorly, and the right posteriorly. Each of these nerves forms a plexus so as nearly to surround the œsophagus, as they descend on it; but the net-work is thickest on the posterior side. They pass through the diaphragm with the œsophagus, and unite again so as to form considerable trunks.

The *Anterior*, which is the smallest, proceeds along the lesser curvature of the stomach to the pylorus. Some of its fibres are spread upon the anterior side of the stomach and the lesser omentum. Others of them extend to the left hepatic, and also to the solar plexus.

The *Posterior* trunk sends branches to surround the cardiac orifice of the stomach. Many branches are spread upon the under side of the great curvature of the stomach. Some of them pass in the course of the coronary artery to the cœliac, and unite to the hepatic and splenic plexus; and one trunk, which is thick, although short, proceeds to the solar plexus.

The Accessory Nerve of Willis,

Which has been mentioned as associated with the eighth pair of nerves, within the cranium, has a very peculiar origin.

It arises by small filaments, which come off from the spinal marrow, between the anterior and posterior fasciculi of the cervical nerves, and proceeds upwards to the great occipital foramen, between these fasciculi. It commences sometimes at the sixth or seventh cervical vertebra, and sometimes about the fourth. It enters the cavity of the cranium through the foramen magnum, and proceeds upwards and outwards, so as to join the eighth pair of nerves at some distance from its origin, and in this course it receives filaments from the medulla oblongata.

After approaching very near to the eighth pair of nerves, it accompanies it to the foramen lacerum, and passes out in its own separate sheath. It then leaves the eighth pair and descends towards the shoulder, proceeding through the sterno-mastoid muscle. Soon after it emerges from the cranium, it sends a ramification to the pharyngeal branch of the *Par vagum* and another to the *Par vagum* itself. After passing through the upper and back part of the sterno-mastoid muscle it terminates in the trapezius. It adheres to the ninth pair of nerves as it passes by it, and sends a twig to the sub-occipital and some of the cervical nerves. It also gives ramifications to the sterno-mastoid muscle as it passes through it.

It has already been stated that the Laryngeal and Recurrent Nerves appear to answer different purposes in their distribution to the Larynx.—When both of the recurrent nerves are divided in a living animal, the voice seems to be lost. When the laryngeal nerves only are divided, the strength of the voice remains, but it is flatter. The recurrent nerves, therefore, seem essential to the formation of the voice. The laryngeal nerves are necessary to its modulation.

The history of the investigation of this subject is contained in Mr. Haighton's paper in the third volume of Memoirs of the Medical Society of London.

THE NINTH PAIR OF NERVES.

Each of these nerves arises from the groove in the medulla oblongata, between the corpora pyramidalia and the corpora olivaria. Three or four fasciculi, of distinct filaments, unite to form it. Thus composed, it proceeds to the anterior condyloid foramen of the occipital bone, and passes through the dura mater. It seems firmly united, by the cellular membrane, to the eighth pair, and to the first ganglion of the sympathetic, soon after it passes from the occipital bone. It is either connected to the sub-occipital nerve by a small ramification, or it joins a branch which pro-

ceeds from the sub-occipital to the cervical, and bends round the transverse process of the atlas. It passes between the internal carotid artery and the internal jugular vein, and crosses the external carotid at the origin of the occipital artery. At this place it generally sends downwards a large branch which is called the *Descendens Noni.* Passing forwards, it is on the outside of the posterior portion of the digastric muscle, and inclines downwards; but near the tendon of the muscle it turns upwards, and proceeds on the inside of the mylo-hyoideus, where it divides into ramifications, which, at the anterior edge of the hyo-glossus muscle, begin to enter into the substance of the tongue, between the genio-glossus and the lingualis muscles.

Some of the branches of this nerve unite with those of the lingual branch of the fifth pair. Others are distributed to almost all the muscles connected with the tongue.

The branch called *descendens noni* passes down in the course of the common carotid artery, and sends branches in its progress to the upper portions of the coraco-hyoidea and sterno-thyroidea muscles; it unites with ramifications of various sizes from the first, second and third cervical nerves, which form a bow under the sterno-mastoid muscle, from which ramifications go to the lower portions of the sterno-hyoidei and thyroidei muscles and of the coraco-hyoidei

OF THE CERVICAL NERVES.

The tenth or last pair of the head, commonly called the *Sub-occipital,* may be arranged with these nerves, because they arise, like them, from the medulla spinalis, and are distributed to the muscles on the neck.

The SUB-OCCIPITAL *Nerves*

Arise on each side of the spinal marrow, nearly opposite to the interval between the great foramen of the os occipitis and the atlas.

Each of these nerves consists of an anterior and posterior fasciculus, or bundle of fibres, which pass outwards immediately under the vertebral arteries, and form a ganglion, from which proceed an anterior and a posterior branch.

The anterior branch is united to the second cervical nerve below, and to the ninth nerve, or the hyoglossal, above. It also sends filaments to the upper ganglion of the great sympathetic nerve.

The posterior branch is spent upon the *Recti*, the *Obliqui*, and some other muscles of the head.

The *proper Cervical Nerves* consist of *seven pairs;* of which the first six go off between the vertebræ of the neck, and the seventh between the last of the neck and the first of the back.

The FIRST CERVICAL *Nerve*

Passes out between the atlas and the *Vertebra Dentata.* It originates from two fasciculi, which are connected to each other at a ganglion, and then separate into an anterior and a posterior branch.*

The anterior branch is connected by filaments with the accessory nerve, with the ninth pair of the head, and with the upper ganglion of the sympathetic. It is also connected with the second cervical nerve, and sends some branches to the muscles on the anterior part of the spine.

The posterior branch, after communicating with the posterior branches of the sub-occipital and the

* This arrangement is common to the nerves of the spine. The ganglion is formed by the posterior fasciculus.

second nerves of the neck, perforates the complexus muscle, and ascending upon the back of the head, is distributed with the occipital artery.

THE SECOND CERVICAL NERVE

Sends off, from its *Anterior Branch,* a twig which descends to the lower cervical ganglion of the sympathetic, and a considerable ramification to the third cervical nerve. It also sends off some twigs to the sterno-mastoid muscle, and others to join the accessory nerve. Some of its small ramifications pass down upon the external jugular vein, and others unite with the descending branch of the ninth pair of the head. A small branch is also concerned in the formation of the phrenic nerve. Two larger branches of this nerve wind round the posterior edge of the sterno-mastoid, and are spread under the integuments of the anterior, lateral, and posterior parts of the neck and lower parts of the head; they have a communication with the portio dura of the seventh pair.* The posterior branch of this nerve is spent upon the extensor muscles of the head and neck.

THE THIRD CERVICAL NERVE

Sends down, from its *Anterior Branch,* the principal trunk of the phrenic nerve. It also sends twigs to the fourth cervical, to the lower cervical ganglion of the intercostal, and to the descending branch of the ninth of the head. Some of its branches unite with twigs of the accessory nerve, and others are spent upon the muscles and integuments of the shoulder and lower part of the neck. A small *Posterior Branch* is spent upon the muscles of the back of the neck.

* These superficial branches have sometimes been described as coming from a plexus; but they often arise directly from the Second Cervical nerve.

THE NERVES OF THE DIAPHRAGM

Are generally denominated the *Phrenic*. The principal root of each of them is commonly derived from the third cervical nerve, but frequently the second and the fourth cervical nerves contribute to the formation; and they are sometimes joined by a twig which is derived from the ninth pair.

Each nerve proceeds down the neck, between the rectus capitis major and the scalenus anticus, and continues along the fore part of the scalenus anticus; it descends into the thorax within the anterior end of the first rib, between the subclavian vein and the artery. It sometimes receives a twig from the fifth cervical nerve, and a twig passes between it and the great sympathetic. After entering the thorax, they descend, attached to the mediastinum, before the root of the lungs. In consequence of the projection of the point of the heart to the left, the course of the left is a little different from that of the right; that of the right proceeding in a more perpendicular direction. When they arrive at the diaphragm, they divide into many ramifications, which have a radiated arrangement, and terminate on the fibres of that muscle, both on the upper and lower surface. Some fibres from each nerve are continued downward, and communicate in the abdomen with fibres from the intercostal.

THE FOURTH, FIFTH, SIXTH, AND SEVENTH CERVICAL NERVES

May be comprised in one description. They pass off successively from the Medulla Spinalis, between the vertebræ, like the other nerves. Their *Posterior Branches* are generally distributed to the back of the neck, and are very small. Their *Anterior Branches* are principally appropriated to the upper extremities, and are large. They generally send each a

small twig to the lower cervical ganglion of the intercostal nerve, and a few small branches to some of the contiguous muscles. They are arranged and combined so as to form the net-work, now to be described, which is called the *Brachial* or *Axillary plexus;* and, in the formation of this plexus, they are joined by the first dorsal nerve.

The BRACHIAL PLEXUS

Extends from the lower part of the side of the neck into the arm-pit. It commences in the following manner. The fourth and fifth cervical nerves proceed downwards, and after uniting to each other about an inch and a half below their egress from the spine, they separate again, almost immediately, into two branches.

The sixth cervical nerve, after passing downwards, divides also into two branches, one of which unites with the uppermost branch that proceeds from the union of the fourth and fifth, and the other with the lowermost, and they all proceed downwards.

The seventh cervical is joined by the first dorsal, which proceeds upwards, and unites with it at a short distance from the spine. The cord produced by their junction soon unites with one of the cords above described. As these different cords proceed downwards, they divide, and their branches again unite. The axillary artery, which passes in the same direction, is surrounded by them. In this manner the axillary plexus is often formed.

The muscles about the shoulder, both before and behind, are supplied by the axillary plexus. Thus, it sends branches to the *Sub-scapularis, Teres Major,* and *Latissimus Dorsi,* behind; and to the *Pectoralis Major* and *Minor,* and the *Mamma,* before. It also sends off a branch called the *Scapularis,* which com-

monly arises from the upper part of the plexus, and proceeds through the notch in the upper costa of the scapula to the supra and infra spinatus, teres minor, &c.

Nerves of the Arm.

All the great nerves of the arm are derived from the axillary plexus. There are six of them, which are denominated *The Musculo Cutaneus; The Median;** *The Cubital,* or *Ulnar; The Internal Cutaneus; The Radial* or *Muscular Spiral;* and the *Circumflex* or *Articular.*

The *Musculo Cutaneus,* or *Perforating Nerve,* passes obliquely through the upper part of the coraco brachialis muscle. Before it enters the muscle, it sends a branch to it. After leaving the muscle, it passes down the arm between the biceps and the brachialis internus, to which it also gives branches. It proceeds to the outside of the biceps, and continues under the median cephalic vein to the anterior and external part of the fore-arm; along which it passes under the integuments. On the lower part of the fore-arm it divides into many branches, which extend to the root of the thumb and the back of the hand, and terminate in the integuments.

The *Median Nerve,* which is one of the largest of the arm, often proceeds from the axillary plexus next to the musculo cutaneus; it passes down the arm, very near the humeral artery, within the edge of the biceps flexor muscle, and, during this course, gives off no branches of any importance. After passing the bend of the elbow, it proceeds under the aponeurosis of the biceps, between the brachialis internus and the pronator teres, and continues down near

* Sometimes called Radial.

the middle of the fore-arm, between the flexor sublimis and the flexor profundus. At the elbow it sends branches to several muscles on the anterior side of the fore-arm, and to the integuments. Among these branches is one, called the *Interosseal Nerve,* which passes down on the anterior surface of the interosseal ligament, with the artery of that name. This nerve sends branches, in its course, to the long flexor of the thumb, and the deep flexor of the fingers. When it arrives at the pronator quadratus, it sends branches to that muscle, and, passing between it and the interosseus ligament, perforates the ligament, and soon terminates on the posterior side of the wrist and hand.

As the *Median Nerve* proceeds downwards, it becomes more superficial; and continuing among the tendons of the flexors of the fingers, it gives off a branch which is principally spent upon the integuments of the palm of the hand. This great nerve passes with the tendons under the annular ligament; and immediately after, while it is covered by the *Aponeurosis Palmaris,* and by that portion of the artery which is called *Arcus Sublimus,* it divides into branches, which separate from each other at acute angles, and subdivide so as to send a ramification to each side of the thumb, of the index, and of the middle finger; and to the radial side of the ring finger.

The *Cubital* or *Ulnar Nerve* is also of considerable size. It passes down on the inside of the triceps extensor muscle, to the great groove formed by the olecranon process and the internal condyle of the os humeri; and, in this course, it often sends a branch to the triceps, and some smaller twigs to the upper part of the fore-arm. From the groove it proceeds on the anterior part of the fore-arm, between the flexor carpi ulnaris and the flexor sublimis, to the wrist. At a small distance above the wrist it sends off a branch,

called the *Dorsalis*, which passes between the flexor ulnaris and the ulna, to the back of the fore-arm and wrist, where, after sending ramifications to the integuments and contiguous parts, it divides into branches which pass to the little finger and the finger next to it. Those branches send off, in their course, many twigs which pass to the skin and cellular substance.

The ulnar nerve then proceeds with the artery, over the annular ligament, on the radial side of the os pisiforme, and divides into two branches; one of which is superficial, and the other deep-seated.

The *Superficial* divides into two principal branches, an external and an internal. The external passes under the aponeuoris palmaris; and, after sending a branch to combine with one from the median and some twigs to the contiguous muscles, it subdivides into two branches, one of which goes to the ulnar side of the ring finger and the opposite side of the little finger. The other branch sends off some twigs to the muscles, and proceeds along the ulnar side of the little finger.

The *Deep-seated* palmer branch of the ulnar nerve passes between the muscles of the little finger, under the tendons of the flexors, and accompanies the deep-seated arterial arch in the palm of the hand, giving branches to the interossei, and other contiguous muscles.

The *Radial* or *Muscular Spiral* nerve is one of the largest nerves of the arm. It passes from the axillary plexus downward, backward, and outward, under the triceps muscle to the external side of the os humeri. In this course, it gives off several branches to the different portions of the triceps. It also frequently gives off a large branch, which passes downwards on the outside of the olecranon, to the back of the fore-arm, and continues to the back of

the hand, furnishing many branches which terminate in the integuments. It then proceeds downwards between the supinator radii longus and the brachialis internus. Immediately after passing the articulation of the elbow, it divides into two branches, denominated the *Superficial* and the *Profound.* The *Superficial* soon joins the radial artery, and proceeds downwards, sending branches to the contiguous muscles. In its course about the middle of the arm it crosses the tendon of the supinator longus, and proceeds between it and the tendon of the extensor carpi radialis langior; it soon after divides the two branches, which are principally distributed to the thumb and fore-finger, and also to the integuments.

The *Profound* branch proceeds to the back of the fore-arm under the radial extensor, and continues to the back of the wrist and hand. In this course it divides into two branches, which are distributed to the contiguous muscles and tendons, and the integuments.

The *Internal Cutaneus* nerve is the smallest of the nerves which proceed from the axillary plexus. It descends in the course of the basilic vein, and very near it. Above the elbow it divides into an *Internal branch,* which proceeds over the *Basilic Vein,* and separates into branches that pass down on the side of the fore-arm; and an *External Branch* that passes under the *Median Basilic Vein,* and continues down on the anterior part of the fore-arm.

The *Articular* or *Circumflex* nerve proceeds backwards from the plexus, between the teres major and minor, and passes nearly around the body of the os humeri, at a small distance below its head. It is distributed to the contiguous muscles and to the articulation; but its principal branches terminate in the deltoid muscle.

THE DORSAL NERVES

Proceed from the cavity of the spine between the dorsal vertebræ. They are sometimes called *Intercostals*, because they pass between the ribs, like the blood vessels of that name. There are twelve pairs of them, and they are named numerically, beginning from above.

These nerves proceed from the medulla spinalis by two fasciculi of fibres—one from each of its lateral portions—the posterior fasciculus is the largest. After passing through the lateral foramen and the dura mater, a ganglion is formed by the posterior fasciculus: the anterior fasciculus unites to this ganglion at its external extremity; and one nerve is formed, which almost immediately divides into an anterior and a posterior branch, of which the anterior is the largest.

The posterior branch proceeds backwards, and is distributed to the muscles of the back. The anterior branch passes towards the angle of the rib, in contact with the pleura. Soon after its origin, this anterior branch sends off two ramifications which unite to the intercostal nerve, at the ganglion; it then proceeds forwards with the blood vessels, between the internal and external intercostal muscles, in the groove near the lower margin of the ribs; and terminates on the anterior part of the thorax. In its course it sends branches, not only to the intercostal muscles and pleura, but to the other muscles and the integuments of the thorax.

Some of the dorsal nerves differ from the others, as to the ramifications which they send off.

The *first nerve*, of this order, joins the lower cervical nerves in the axillary plexus; but it sends off the ramifications to the sympathetic, and also a

branch, which passes under the first rib, like the other dorsal nerves.

The *second nerve* sends off a branch, which passes through the external intercostal muscle into the axilla, and combines there with a branch of the cutaneous nerve, being distributed to the internal and posterior part of the arm.

The third dorsal nerve also sends off a branch, which is distributed to the axilla and the back part of the arm.

These branches of the second and third dorsal nerves, are called intercosto-humeral nerves.

The lower dorsal nerves supply the muscles and integuments of the abdomen.

Of the LUMBAR Nerves.

There are five pairs of these nerves. The first of them passes off between the first and second of the lumbar vertebræ, and the others succeed regularly; so that the last pair is situated between the last lumbar vertebra and the sacrum.

The first lumbar nerves arise from the medulla spinalis, before it forms the cauda equina; the other four pair are formed by the cauda equina.

They commence by anterior and posterior fasciculi, which are united at a ganglion. From these ganglion, anterior and posterior branches go off, which are very different in size, the anterior being the largest.

The posterior branches are distributed to the muscles of the back. The anterior sends branches to the ganglions of the sympathetic nerve, and also communicate with each other to form the *Lumbar Plexus*, which is situated on the lateral parts of the bodies of the Lumbar Vertebræ, before their transverse processes, and supplies nerves to the muscles of the thigh.

THE FIRST LUMBAR NERVE

Is connected, by its anterior branch, to the last dorsal and the second lumbar. From the same branch ramifications go off to the Quadratus Lumborum, and obliquely across that muscle, to the lower part of the abdominal muscles near the spine of the ilium.

THE SECOND LUMBAR NERVE

Sends off a muscular branch downwards and outwards: it also sends off the small branch, called the *External Spermatic,* which passes down in such a direction, that it perforates the transversalis and the obliquus internus muscles, near their lower margin, at a small distance from the superior anterior spine of the ilium, and then proceeds within the lower edge of the tendon of the external oblique to the abdominal ring, through which it passes. In the male it is distributed to the spermatic cord and scrotum, and in the female to the labia pudendi. In the female it also sends a branch to the uterus.* The *Second Lumbar,* after sending off these branches, passes downwards, and joins the *Third* lumbar nerve. From this union of the second and third nerves, a branch called the *Cutaneus Medius,* which will be soon described, proceeds downwards.

After sending off this branch, the united trunk of the second and third joins the *Fourth;* and from this union is sent off the *Obturator Nerve,* which passes through the aperture in the membrane that closes the foramen thyroideum; the *Crural Nerve,* which passes under Poupart's ligament; and a *third branch* that proceeds downwards, and joins the *Fifth* lumbar nerve. The *Fifth* lumbar nerve, with this accession from above, descends into the pelvis, and unites with the sacral nerves.

* The external spermatic often comes off from the first lumbar nerve.

This arrangement of the lumbar nerves constitutes the *Lumbar Plexus*, which, as has been already stated, furnishes three nerves to the lower extremity, namely, the *Cutaneus Medius*, the *Obturator*, and the *Crural Nerve.*

The *Cutaneus Medius*, which arises from the union of the second and third nerves, as has been already observed, proceeds downwards, and frequently adheres to the crural nerve, for a short distance, near Poupart's ligament, but soon leaves it, and descends on the inside of the thigh, supplying the integuments as low as the knee.

THE OBTURATOR NERVE

Descends into the pelvis, and passes out of it at the upper part of the foramen thyroideum; proceeding downwards in an internal direction, to be distributed on the inside of the thigh.

This nerve is generally accompanied by the obturator artery and vein; the artery being above, and the vein below it. When it has arrived at the foramen ovale or thyroideum, it sends of a branch to the internal and external obturator muscles, and, after passing these muscles, divides into two branches, which are distributed to the muscles on the inside of the thighs, the adductors, the pectineus, the gracilis, &c.

THE CRURAL NERVE

Is situated at first behind, and then on the outside of the psoas muscle. It passes under Poupart's ligament with the great femoral vessels, being on the outside of the artery.

It is distributed to the integuments, and also to the muscles, which are situated on the anterior and internal parts of the thigh. Some of its ramifications go off before it passes under Poupart's ligament.

Several of them are spent upon the integuments, and are, therefore, denominated *Cutaneus.*—They are distinguished by the terms *Cutaneus Anterior, Cutaneus Internus*, &c., according to their situations.

The deep-seated branches are the largest. They are principally spent upon the muscles on the anterior and the internal side of the thigh, namely, the four extensors, the adductors, the pectineus, the sartorius and the gracilis. Among these nerves there is one, called the *Saphenus*, which has a different destination. It accompanies the great artery of the thigh to the place where it perforates the *Adductors*; it there separates from the artery, and passes over the tendon of the *Adductors*, under the sartorius muscle; thence it continues, with the great saphena vein on the inside of the leg, to the internal ankle; sending branches to the integument, in its course. It terminates in skin and cellular substance on the upper and internal surface of the foot.

The SACRAL Nerves

Are composed of those cords of the cauda equina which remain after the formation of the lumbar nerves. They are frequently stated to consist of five or six pairs, four of which pass through the foramina of the sacrum, and the fifth between the sacrum and the os coccygis.* The cords of which they are respectively composed arise by anterior and posterior fasciculi. When they have arrived opposite to the foramina of the sacrum, through which they are to pass, a ganglion is formed, at which they unite, and then divide into *anterior* and *posterior* branches.† The uppermost of the anterior branches

* The sixth pair, when they exist, proceed in a groove in the os coccygis.

† The ganglions of the fourth and fifth nerves are extremely small, and not so near the formina as those of the others.

are large, and pass through the anterior foramina of the sacrum. The posterior are small, and go through the posterior foramina.

The *Posterior branches* are generally spent upon the muscles which lie on the sacrum and posterior parts of the pelvis, externally.

The anterior branches of the three first nerves send ramifications to the sympathetic. They unite to each other, and are joined by the last lumbar nerve, and by a branch of the fourth sacral, in the formation of the great sciatic nerve. This union constitutes the *Sciatic plexus.*

The anterior branch of the fourth nerve transmits branches to the sympathetic: it also sometimes sends a branch to the united nerves above, or the sciatic plexus. It sends branches to the hypogastric plexus, and to the contiguous muscles.

The fifth and sixth pairs, which are very small, terminate also in the contiguous muscles and in the integuments.

From the *Sciatic plexus*, or the nerves which compose it, several smaller branches go off. There are generally two which pass off backwards through the ischiatic notch, and are denominated *Gluteal*, as they are distributed to the glutei muscles. From the lowermost of these a branch descends on the thigh.

The *Pudic nerve*, which is appropriated to the organs of generation, also passes off from this plexus, and appears to consist of fibres which are derived from each of the nerves that compose it. It proceeds between the sacroischiatic ligaments, and divides into two branches—an inferior and a superior. The *inferior* passes between the erector penis and the accelerator urinæ muscles, and is distributed to those muscles, to the bulb of the urethra and the interior of that canal, to the scrotum and dartos.

The *superior* proceeds along the os pubis to the

symphysis, and passes between the bone and the body of the penis to the dorsum. A considerable branch accompanies the artery on the dorsum, and terminates by many ramifications, on the glans penis; after sending branches in its course to the integuments generally, and to the prepuce.

In females, the *Inferior pudic nerve* proceeds along the external labia pudendi to the mons veneris, sending off many ramifications in its course.

The *Superior pudic nerve* proceeds as in males, along the branch of the pubis to the superior surface of the clitoris, and terminates principally upon the extremity of that organ.

The sacral nerves unite in the sciatic plexus to form the great nerve of the lower extremity, which is next to be described.

The GREAT SCIATIC *Nerve*

Proceeds from the pelvis through the ischiatic notch, between the pyramidalis, and the superior gemellus muscle; it then passes down to the back part of the thigh, between the tuberosity of the ischium and the great trochanter of the os femoris; and continues downwards, inclining from within outwards, to the ham, where it is situated between the tendons of the semi-tendinosus and semi-membranosus on the internal side, and the tendon of the biceps on the external. In this course it sends off branches to the muscles on the posterior part of the thigh.

As the great nerve passes down the thigh, it sends off obliquely downwards and outwards, a large branch which is called the *Fibular,* that passes across the head of the fibula to the external and anterior part of the leg. The place where this branch separates from the main nerve is different in different subjects. It continues in contact with it

for some distance, connected only by cellular membrane.

THE FIBULAR OR PERONEAL NERVE

Proceeds downwards on the inside of the tendon of the biceps, and crosses obliquely to the outside of the external head of the gastrocnemius: it then passes inwards between the long peroneus muscle and the fibula: and descending between the muscles on the front of the leg, divides into two branches, one of which inclines to the exterior side of the leg, and the other preserves an internal situation. In its course from the great sciatic nerve to the fibula, it sends off some superficial ramifications. The two branches into which it divides, after passing over the fibula, continue downwards. The *Internal*, after supplying the muscles on the anterior part of the leg, passes under the annular ligament like the anterior tibial artery; and on the upper part of the foot, divides into two ramifications, one of which proceeds forwards near the internal edge of the foot and the other near the external; they divide again, and are distributed to the parts on the upper surface of the foot, one of their ranula descending with the continuation of the anterior tibial artery to the sole of the foot.

The *External Branch* of the fibular nerve, as it proceeds downwards, supplies ramifications to the contiguous muscles, and passing through the fascia on the outside of the leg, continues between it and the skin towards the foot. In this course it generally divides into two branches, which are spent upon the upper surface of the foot.

The *GREAT SCIATIC Nerve*, after the fibular nerve leaves it, continues down the thigh, between the tendons of the flexors, behind the great blood vessels, and, of course, exterior to them.

In the ham, this great nerve takes the name of *POPLITEAL*, and proceeds across the articulation of the knee, between the heads of the gastrocnemii, to the posterior side of the tibia: here it passes through the upper portion of the soleus or gastrocnemius internus, and continues between it and the long flexor of the toes, near the *Posterior Tibial Artery*; descending with that artery to the hollow of the os calcis. In this situation it has the name of

POSTERIOR TIBIAL NERVE.

At the commencement of this course, a small distance below the internal condyle of the os femoris, it sends off a branch of considerable size, called the *Communicans Tibia*, or *Saphena Externa*, which passes down behind the gastrocnemii, and gradually inclines externally, so that it is situated on the external edge of the tendo Achillis, soon after the commencement of that tendon, and proceeds behind the external ankle, near the outer side of the foot, to the smaller toes: distributing branches to the contiguous parts. In its course on the back of the leg, it sends off a branch which unites with one of the superficial ramifications of the fibular nerve, and descends to the outer part of the foot.

The *Tibial Nerve*, in its course downwards, sends branches to the contiguous muscles, and a few twigs which form a species of net-work on the artery. In the hollow of the os calcis it sends off a superficial branch to the integuments of the sole of the foot, which proceeds on the outside of the aponeurosis plantaris: it there also divides into branches, which are denominated the *Internal* and *External Plantar Nerves*.

The *Internal Plantar Nerve* proceeds forwards, alongside of the tendon of the long flexor muscle of the great toe, giving off small branches in its course,

About the middle of the foot it divides into four branches, one of which proceeds to the inside of the great toe; and a second to the angle formed by the great toe and the toe next to it, where it divides and sends a branch to the opposite sides of those toes: the other two branches are distributed in a similar manner, to the succeeding toes. These digital branches are connected with each other by small ramifications.

The *External Plantar Nerve* proceeds with the external plantar artery towards the external side of the foot, between the short flexor of the toes and the flexor accessorius. Near the external edge of the foot, about the posterior end of the metacarpal bones, it divides into three branches. One proceeds to the outside of the little toe; another passes to the angle between the fourth toe and the little toe, and divides into branches which are distributed to the corresponding sides of these toes. The third branch proceeds more deeply in the foot, from the external towards the internal edge of it, and is spent upon the deep-seated contiguous muscles.

THE GREAT SYMPATHETIC OR INTERCOSTAL NERVE

Commences in the cranium with those small ramifications of the pterygoid branch of the upper maxillary nerve, and of the sixth pair, which accompany the carotid artery through the canal in the petrous portion of the temporal bone. These small nerves form a net-work which surrounds the artery in the canal and gives rise to the incipient sympathetic, a small cord which passes down close to the nerves of the eighth and ninth pairs of the neck. Opposite to the second cervical vertebra, this nerve is swelled or dilated, so as to form a body of a light red colour, which is more than an inch in length, and has the form of two cones united to each other at their

bases. This is the *Superior Cervical Ganglion* of the *Sympathetic Nerve,* and from it the nerve descends, behind the *Par Vagum,* on the front part of the neck.

This ganglion receives twigs from the first, second, third and fourth pairs of cervical nerves, and also from the eighth and ninth nerves of the head. It sends off several twigs, which pass behind the carotid artery, at its bifurcation, and are joined by twigs of the *Portio Dura* and the *Glosso-Pharyngeal* nerves. From these united twigs proceed very small ramifications, which accompany several branches of the external carotid artery, and some of them pass down with the *Common Carotid.*

This superior ganglion also furnishes small twigs which accompany the *Glosso-Pharnygeal* to the tongue and pharynx. Sometimes a twig from it passes on the back part of the thyroid gland to communicate with the recurrent nerve. From this ganglion go off some small branches, which, uniting with others from the superior laryngeal nerves, form the superior or superficial *cardiac* nerve, which will be soon described.

The trunk of the *Sympathetic Nerve* descends, on the front of the neck, from this ganglion, as has been already stated. In its course it receives very small twigs from the fourth and fifth cervical nerves, and sends some very small twigs which appear to go to the œsophagus, and some which unite to the laryngeal nerve and go to the thyroid gland. Some twigs which are larger proceed from it into the thorax, and go to the cardiac plexus hereafter to be described.

Opposite to the interval between the fifth and sixth cervical vertebræ it forms another ganglion, of an irregular shape, much smaller than the first. This ganglion, in different subjects, differs in size as well as in several other respects. Sometimes it is en-

tirely wanting, and sometimes it is doubled. It is denominated the *Middle Cervical,* or *Thyroid Ganglion.* When the fourth, fifth, and sixth cervical nerves do not send ramifications to the sympathetic nerve, this ganglion receives twigs from them.

The *Middle Cervical,* or *Thyroid Ganglion* sends many ramifications downwards. Some of them enter the thorax and contribute to the formation of the *Cardiac Plexus;* others accompany the inferior thyroid artery, and, with twigs from the recurrent nerve, form a plexus which extends towards the thyroid gland. Some proceed downwards before, and others behind, the subclavian artery, to the next ganglion; among them is generally one which may be regarded as the trunk of the *Sympathetic.*

This third *Ganglion* is denominated the *Inferior Cervical,* or the *First Thoracic.* It is almost constantly found in the same situation, viz. between the transverse process of the last cervical vertebra and the head of the first rib, and is partly covered by the origin of the vertebral artery. It is generally larger than the middle ganglion. It receives branches from the sixth and seventh cervical, and the two first dorsal nerves. Ramifications pass from it to the par vagum and recurrent nerve, and also to the cardiac and pulmonary plexus.

From this ganglion the *Sympathetic Nerve* proceeds downwards on the side of the spine, as will be described hereafter.

The Nerves of the Heart,

Being derived from branches which have already been mentioned, are now to be described.

They arise principally from an arrangement of nerves denominated the *Cardiac Plexus,* or *Plexuses,* which is situated above the curve of the aorta, and extends, on the posterior side of it, from the root of the arteria innominata to the bifurcation of the pul-

monary artery. This plexus is composed of nerves which are principally formed by the union of small ramifications that are derived from the three above mentioned ganglions of the *Sympathetic Nerve,* and the nerve itself; and also from the *Par Vagum,* and some of its branches.

These nerves are denominated the *Cardiac.* They descend on their respective sides of the neck, but are somewhat different on the different sides. On the *right* side three nerves have been described as particularly entitled to this name, and on the *left* side but two.

The first on the *right* side is denominated *Superior,* or *Superficial Cardiac Nerve.* It generally arises by several fine threads, which unite into one delicate cord that passes down by the side of the common carotid. When it has arived on a line with the middle ganglion, it sends a twig to the thyroid plexus, and another that communicates with a twig from the par vagum, which continues downwards on the carotid artery. After passing beyond the ganglion, it divides into several branches, which unite themselves to branches of the recurrent nerve that are going to the middle ganglion.

The second, which is denominated the *Middle Cardiac,* the *Great Cardiac,* or the *Deep Cardiac,* is the largest of the three. It arises from the *Middle Cervical,* or *Thyroid Ganglion,* by five or six fine fibrils, which finally form one, that passes before and across the subclavian; and at that place, as well as lower down, it receives twigs from the par vagum: below this, it is joined by a considerable twig from the recurrent, and terminates in the *Cardiac Plexus,* to which it contributes largely.

The third cardiac nerve of the right side is called the *Inferior,* or the *Small Cardiac Nerve.* It originates from the third, or lower cervical ganglion, by

many fibrils which unite into a smaller number that form a plexus. It crosses behind the subclavian, and proceeds on the outside of the Arteria Innominata to the curve of the aorta; continuing between it and the pulmonary artery, to the anterior coronary plexus. In this course it receives several fibres from the recurrent and the par vagum.

On the left side the first cardiac nerve arises from the upper ganglion. The second derives its origin from the two lower ganglions.

The left superior or superficial cardiac nerve arises like the right, by many distinct fibres, and proceeds downwards in the same way. It descends between the carotid and the subclavian, and when it has arrived at the place where they originate from the aorta, it divides into a great number of small ramifications. Some pass before the aorta, either to join the branches of the inferior cardiac, or to unite with the cardiac branches of the left nerve of the par vagum. The others proceed behind the aorta, and enter into the common cardiac plexus.

The second cardiac nerve of the left side may be called the *Great Left Cardiac*, and has a double origin, as above mentioned. The principal branch in its composition arises from the lowest cervical ganglion, and passes behind the transverse portion of the subclavian artery. Where the inferior thyroid arises from the subclavian, this branch receives a considerable number of ramifications, which arise from the upper ganglion, and are interwoven with each other before they unite to it. It passes behind the curve of the aorta, and terminates in the great cardiac plexus, which it particularly contributes to form. Here it is joined by many fibres from the par vagum.

The Cardiac Plexus

Is situated principally behind the curve of the aorta, at a small distance above the heart. It commences as high as the origin of the Arteria Innominata, and extends downwards to the bifurcation of the pulmonary artery.

As has been already mentioned, it is principally composed of branches from the middle cardiac nerve of the right side, and the inferior cardiac nerve of the left; but it receives branches from the superior cardiac of the left, and sometimes of the right side. Some fibres of the inferior cardiac of the right are also united to it.

Many branches proceed from this plexus.

A small number pass upon the aorta, and seem to enter into its texture.*

Some of them also combine with the ramifications of the *Par Vagum* in the anterior pulmonary plexus.

The majority proceed to the basis of the heart, near the origin of the pulmonary artery and the aorta, and constitute the *proper nerves of that organ*. They accompany the coronary arteries, and are so arranged around them that, by some anatomists, they have been said to form plexuses, which have been denominated *Coronary*.

The *Sympathetic Nerve*, as has been stated above, proceeds from the ganglion, called the *Lower Cervical*, or the *First Thoracic*, before the neck of the first rib. It continues to descend, in the same direction, along the spine, exterior to the pleura, to the inferior part of the thorax. Near the head of each rib it forms a ganglion, which unites with the intercostal nerve behind it, by two branches, and thus forms an indirect communication with the medulla spinalis.

* It has been asserted that some of the anatomists of Paris have traced these nerves on the aorta, to a great distance from the heart.

From several of the uppermost of these ganglions small twigs proceed to the pulmonary plexus, and also to the great trunk of the aorta, below the curve forming a species of net-work, or plexus upon it.

From the ganglions near the heads of the fifth and sixth ribs, and from four or five of the ganglions which succeed them, small nerves arise, which proceed downwards on the sides of the bodies of the vertebræ, and unite into one trunk that is denominated the *Splanchnic Nerve,* because it is distributed to the viscera of the abdomen.—This nerve proceeds behind the crus of the diaphragm, on its respective side, into the abdomen. A second and smaller nerve, of the same destination, called the *Lesser Splanchnic Nerve,* arises lower down, from two or three of the lowermost dorsal ganglions, and penetrates separately into the cavity of the abdomen: it then generally divides into two branches, one of which unites to the great splanchnic nerve, and the other proceeds to the *renal plexus* soon to be described.

As soon as the great splanchnic nerve has entered the abdomen, it divides into many branches, which commonly form small ganglions on each side of the cœliac artery, but above it. These ganglions are generally contiguous; but sometimes they are at a small distance from each other, and united by nerves. They are, however, commonly spoken of as one, and called the *Semilunar Ganglion.* They are of irregular forms, and very different from each other in size, as well as form. Those formed by the splanchnic nerve on one side are sometimes different from those on the other.

From this assemblage of ganglions proceed many small nerves, which are woven together so as to form a net-work denominated the *Solar Plexus.*

This plexus is situated anterior to the spine and the crura of the diaphragm, behind the stomach and

above the pancreas; and is extended upon the cœliac and superior mesenteric arteries. Some ramifications from the par vagum and the phrenic also join it.

The lower part of the solar plexus, which surrounds more immediately the cœliac artery, is termed the *Cœliac Plexus*. From it net-work of nerves extends upon the great branches of the artery to the organs to which they go.

They extend to the stomach, (although it is supplied by the par vagum,) along the superior coronary or gastric branch of the cœliac; and the fibres in their composition being spread upon the coats of the stomach, unite with the branches of the par vagum, which are also spread upon them.

A similar net-work, denominated the *Hepatic Plexus*, extends upon the *Hepatic Artery*, and from it to the *Vena Portarum;* and accompanies those vessels into the substance of the liver. It also sends branches to the biliary duct and gall bladder; to the stomach by the arteria gastrica dextra; and to the omentum.

The *Splenic Artery* is invested by a similar but smaller arrangement of nerves, denominated the *Splenic Plexus*. In its course to the spleen, this plexus sends some nerves to the pancreas; and also to the stomach and omentum, with the left gastric artery.

The superior mesenteric artery is surrounded by a net-work, which extends to it directly from the solar plexus, and is the largest of all which proceed from that plexus. The *Mesenteric Plexus* at first nearly surrounds the artery, and proceeds with it between the lamina of the mesentery. In this course it sends branches, with the arteria colica dextra, to the transverse portion of the colon. Between the lamina of the mesentery, it sends ramifications with all the branches of the artery, to the small intestines gene-

rally; to the cœcum, and the right portion of the colon, as well as to the mesenteric glands.

From the lower part of the solar plexus a net-work proceeds, on the front of the aorta, to the inferior mesenteric artery, and surrounds it. Nerves from this plexus accompany the artery to the left portion of the colon and the rectum. Some of their ramifications combine with those of the hypogastric plexus.

The *Emulgent Artery* is attended by nerves, which are arranged like a net-work on its anterior and posterior surfaces, and are denominated the *Renal Plexus*. They are derived from the solar plexus, and frequently contain small ganglions. They proceed with the artery to the fissure of the kidney, and are distributed with its different ramifications, in the substance of the organ.

Some branches pass from them to the renal gland with the capsular artery.

Before the renal plexus arrives at the kidney, it sends off, from its inferior part, some new fibres, which, after joining some others from one of the lumbar nerves, accompany the spermatic arteries, and are, therefore, called the *Spermatic Plexus*. In the male these fibres proceed through the abdominal ring, and many of them go to the testis, but they are followed with great difficulty, on account of their small size.

In the female, they go to the ovary and the Fallopian tubes.

From the great plexuses above, a small net-work continues downwards on the aorta, receiving fibres from the intercostals on each side; at the great bifurcation of the aorta it divides, and is joined on each side by many ramifications from the third lumbar nerves, which thus form a plexus of considerable extent, that sends nerves to the bladder, rectum, and

vesiculæ seminales in males; and to the uterus and vagina, as well as the bladder and rectum, in females.* This is called the *Hypogastric Plexus*.

The plexuses above mentioned are derived from the splanchnic nerve, which come off from the *Sympathetic* in the thorax.

The *Sympathetic Nerve*, after giving off the lesser splanchnic, is diminished in size, and approaches nearer to the bodies of the vertebræ. It passes through the crura of the diaphragm, and then proceeds forwards and downwards upon the spine, between the tendinous crura of the diaphragm and psoas muscle; near the vena cava on the right side, and the aorta on the left. In this course, it generally receives one or two small cords from the anterior branch of each of the lumbar nerves; these cords proceed downwards and forwards, between the bodies of the vertebræ and the psoas muscle, and a ganglion is generally formed at the place where they join the nerve.

In its descent on the lumbar vertebræ, the Sympathetic sends off several nerves that unite to the net-work which descends on the aorta from the plexus above. After passing over the lumbar vertebræ, it descends into the pelvis, close to the sacrum, on the inner side of the great foramina: here it also forms ganglions, and communicates with the sacral nerves, and likewise with the hypogastric plexus. It terminates on the os coccygis, where its minute fibres join those of the opposite side.

* Although the testicle receives nerves which are derived from the Sympathetic, the penis and other external parts of the organs of generation do not: the nerves which accompany the pudic artery being derived from those which unite to form the great Sciatic.

SYSTEM OF ANATOMY.

PART XI.

OF THE ABSORBENT VESSELS.*

The absorbent vessels are small transparent tubes, of a delicate structure, which exist in considerable numbers, in almost every part of the body.

These tubes originate upon the surfaces of all the cavities of the body; and of the cellular membrane, in all the various parts into which it penetrates; upon the internal surface of the stomach and the intestines; and probably upon the skin.

Those which originate in the *Lower Extremities* and the *Cavity of the Abdomen*, unite and form a large trunk called the *Thoracic Duct*, which proceeds through the thorax, and terminates in the left *Subclavian Vein*, at its junction with the *Internal Jugular*. Those of the *Left Upper Extremity*, the *Left Side of the Head*, and the contiguous parts, form a trunk which terminates in the same place. While the remaining absorbents, or those of the *Right Upper Extremity* and the *Right side of the Head, &c.* also form a trunk, which terminates in the corresponding part of the *Right Subclavian Vein*.

* Discovered at Leyden in 1650, by Olaus Rudbeck, and at Copenhagen in 1651, by Bartholine.—Ed.

The absorbent vessels of the middle size, which arise from the union of the small vessels, and unite to form the larger, in their progress to these large vessels, pass through certain bodies which have been denominated *Conglobate Glands*, and may be considered as appendages of the absorbent system.

The absorbent vessels are composed of two coats, which are thin, but dense and firm, and also elastic. The coats of the thoracic duct may be separated from each other. The internal surface of the exterior coat is fibrous. The internal coat is a delicate but strong membrane.—There is great reason to believe that the above mentioned fibres are muscular, or at least irritable; for the absorbent vessels have been observed, by Haller, to contract upon the application of strong sulphuric acid. They have also been observed to propel their contents with considerable rapidity, by their own contraction, independent of pressure, or of motion communicated by any other body.

Blood vessels are sometimes observable in the coats of the larger absorbents, in injected subjects. The vascularity of these tubes may also be inferred from the inflammation which frequently takes place in them.

Nerves have not been traced into their texture; but the absorbents seem to be painful when they are inflamed, and, therefore, it is probable that they are supplied with nerves.

The absorbent vessels are very generally supplied with valves, which are much more numerous in some of them than in others; and are different in their number, in the same vessels, in different subjects.

Very frequently there are several valves in the course of an inch: sometimes a valve will not appear in the course of several inches. In the *Thoracic Duct* the number of valves is very different in different subjects. These valves are folds or plaits of the in-

ternal membrane, and are of a semicircular form. There are commonly two of them together originating from opposite sides of the vessel.

The absorbents are generally somewhat dilated on the side of the valve which is next to their termination, and this occasions their knotted appearance when they are injected. The object of this valvular structure seems to be the prevention of retrograde motion of the contained fluid, in consequence of lateral pressure.

Where the different trunks of the absorbents open into the veins, there are one or two valves to prevent the regurgitation of the blood into them.

The valves of course prevent the injection of the branches of these vessels from their trunks.—In some animals the valves have sometimes been ruptured, or forced back; and the absorbents have been injected in a retrograde direction. There are but two or three instances upon record where this has been practicable in the *Human Subject*.

In consequence of the impracticability of injecting the small branches from the larger, the absorbent vessels cannot, generally, be demonstrated at their commencement, or origin. It is, however, to be observed, that the *Lacteals*, or *Absorbents of the Intestines*, appear no way different from other absorbents; and they have been seen distended with chyle, from their commencement, in certain subjects who had died suddenly. Their origins have been described very differently by different observers.

Mr. Cruikshank describes them as originating on the surfaces of the *villi*, by a number of very small radiated branches with open orifices; which branches soon unite to form a trunk.

Lieberkuhn believed them to commence in the form of an ampullula.—*See page* 105 *of this volume.*

The second Monro also believes that the absorp-

ents begin by very small tubes, with open orifices in several species of fish.*

It is stated by Dr. Soemmering, upon the authority of Haase, a German anatomist, that when mercury is forced backwards in the absorbent vessels of the foot and the heart, it has sometimes escaped on the surfaces of those parts. The probable inference from these facts is, that those vessels originate by open orifices on the surfaces of the heart and foot.

The bodies connected with the absorbent vessels, which are called *Conglobate Glands,* are generally of a roundish, or irregular oval form, and somewhat flattened. They are of various sizes, from two lines in diameter to more than twelve. Their colour is frequently whitish, but sometimes it is slightly inclined to red. They are invested with a covering of cellular membrane, which appears like a membranous coat; and they are connected to the contiguous parts by a loose cellular substance. When the absorbent vessels connected with these bodies approach near to them, they divide into a number of ramifications, most of which enter into the substance of the gland, while some of them run over it. On the opposite side of the gland a number of branches go out, which unite and form trunks similar to those which entered the gland. The vessels which enter the gland are called *Vasa inferentia,* and those which go out of it *Vasa efferentia.*

These vessels are generally much convoluted in the substance of the glands, so that those bodies sometimes appear like a mere convolution of absorbent vessels. There has been much diversity of sentiment respecting the structure of these organs.†

* See his work on the Structure and Physiology of Fishes, p. 34.

† Mr. Abernethy states, that the mesenteric gland of the whale consists of large spherical bags, into which a number of the lacteals open.—Numerous blood vessels are ramified on the surfaces of these cysts;

The absorbent vessels, in the different parts of the body, generally contain fluids resembling those which are found in those parts. Mr. Hewson opened the large absorbents in many living animals of different kinds, and found that they contained a transparent fluid, which coagulated when exposed to the open air.

The arrangement of these vessels resembles that of the veins in several respects. Many of them are superficial; but there are also deep-seated absorbents which accompany the blood vessels.

and injection passes from them into the cyst. He also found cells in the glands of the absorbent vessels, in the groin and the axilla of the horse. —See Philosophical Transactions, for 1796, Part I.

CHAPTER I.

OF THE ABSORBENTS OF THE LOWER EXTREMITIES, THE ABDOMEN, AND THE THORAX.

UNDER this head are arranged the ramifications of all the vessels which unite to form the *Thoracic Duct.*

SECTION I.

Of the Absorbents of the Lower Extremities.

These absorbents, like the veins, are superficial and deep-seated. The *Superficial* lie in the cellular membrane, very near the skin; and form an irregular net-work which extends over the whole limb. They are, however, most numerous on the internal side.

The *deep-seated* accompany the arteries like the veins, and there are two at least to each artery.

The Superficial Absorbents

Have been injected from the toes so as to form a net-work, which occupies the upper surface of the foot. They have also been injected in a similar manner on the sole. Those on the upper surface of the foot generally proceed upward on the anterior and inner side of the leg; but some of them pass on the external side of it. Those on the sole are continued on the back of the leg, but communicate very frequently with the anterior vessels. Some of the absorbents from the outside of the foot and leg enter into some of the popliteal glands, soon to be described; but they are not numerous; and the principal number continues up to the glands of the groin.

The absorbents which originate on the surface of the thigh, as well as those which pass over it from below, incline gradually along the anterior and posterior surface, to the internal side of it; on which they proceed in great numbers, and very near to each other to the inguinal glands. Superficial absorbents proceed also from the buttock and lower part of the back, from the lower part of the abdomen, the perineum and the exterior of the genital organs, to these glands.

The Deep-seated Absorbents

Are named from the arteries they accompany.

The Anterior Tibial Absorbents.

The anterior tibial artery is generally attended by one which comes with it from the sole, and by another which commences on the upper surface of the foot. The first mentioned absorbent continues with the artery. The last often passes through an aperture in the interosseal ligament, about one-third of the distance from the ankle to the knee, and accompanies the fibular artery, while the anterior tibial artery is joined by other absorbents about the same place. In some instances a small absorbent gland occurs in this course at a short distance below the knee.

The Posterior Tibial Absorbents

Have been injected from the under side of the toes. They accompany the ramifications on the sole of the foot; and, after uniting, continue with the main trunk up the leg, where they enter the popliteal glands.

The *Peroneal Absorbents* arise also from the sole of the foot, and its external side. They accompany the peroneal artery, and terminate in the popliteal glands, which receive also the absorbents from the knee and ham.

From these glands four or five absorbent vessels proceed which accompany the great blood vessels of the lower extremity; and, proceeding with them through the aperture in the tendon of the adductors, continue upwards until they enter some of the glands of the groin.

The glands of the ham and groin, which are so intimately connected with the absorbents of the lower extremity, are very different from each other.

The *Popliteal Glands,* or those of the *Ham,* are but three or four in number, and very small in size. They are generally deep-seated, and very near the artery.

The *Inguinal Glands* vary in number from eight to twelve or more. They are superficial and deep-seated. The *Superficial* communicate principally with the superficial absorbents. The lowermost of them are at some distance below Poupart's ligament, and the uppermost are rather above it. They are exterior to the fascia of the thigh. Their number is generally six or eight, while that of the deep-seated is but three or four.

The superficial absorbents from below, approach very near to each other, and enter these glands.— They are commonly distributed among three or four of the lowermost; but some of them pass by these, and proceed to one that is higher up; and sometimes there are absorbent vessels which pass to the abdomen without entering into any of the glands of the groin.

The *deep-seated* absorbents pass into the deep-seated glands, which, as has been already observed, are but few, and lie very near the artery, under the fascia of the thigh. The two sets of glands are connected to each other by many absorbent vessels that pass between them. The vessels which finally go out of these glands are considerably less in num-

ber than those which enter into them. They proceed under Poupart's ligament, and, in some instances, a large proportion of them passes through three glands which lie below this ligament, and are often so arranged, that they lie on each side of the great femoral vessels, and above them. One very frequently is found on the inside of the femoral vein, in the vacuity between it and the internal part of the ligament. All the absorbents of the lower extremity, however, do not enter these glands. Some pass along the great vessels and enter other glands near the margin of the pelvis. Some also descend a short distance into the pelvis, and unite with vessels that are passing from the pelvis to the plexus and the glands that surround the external iliac.

The absorbents which proceed from the glands last mentioned, joined to those which pass under Poupart's ligament, without entering these glands, and some which come from the pelvis, form a large plexus, which almost surrounds the external iliac vessels, and contains many glands.

These *External Iliac Glands* vary in their number from six to ten or twelve. They lie on the side of the pelvis, in the course of the external iliac vessels, and some of them are of considerable size. These glands and the plexus of absorbents, extend in the track of the iliac vessels, to the first lumbar vertebra. In this course they are joined by the plexus which comes from the pelvis; and soon after they arrive at the *Lumbar Glands*, which form a very large assemblage, that extends from the bifurcation of the aorta to the crura of the diaphragm.

These glands lie irregularly on the aorta, the vena cava, and the lumbar vertebræ. Most, if not all, the absorbents above mentioned pass through some of them; and from the union of these absorbents, some

of the great branches, which unite to form the thoracic duct, are derived.

In this course, from the thigh to the lumbar glands, these absorbent vessels are joined by several others. The *Superficial Absorbents* of the scrotum commonly enter into the upper inguinal glands, and thus unite to the great body of absorbents.

The *Absorbents of the Testicles,* originate in the body, and the coats of the testicle, and in the epididymis, and are remarkably large and numerous.—They proceed along the spermatic cord, through the abdominal ring, to the lumbar glands. These vessels are remarkable for the little communication they have with each other.

The *Deep-seated Absorbents of the Scrotum* accompany the absorbents of the testicle to the lumbar glands; but those which are superficial enter the upper inguinal glands.

The *Absorbents of the Penis* are also deep-seated and superficial. The deep-seated arise from the body of the penis, and accompany the internal pudic artery into the pelvis. The superficial absorbents arise from the prepuce, and pass along the dorsum of the penis. There are frequently several trunks which receive branches from the lower surface of the penis in their course. At the root of the penis they generally separate to the right and left, and pass to the glands on the respective sides.

In females, the absorbents of the interior of the clitoris accompany the internal pudic artery. Some, which arise about the vagina, pass through the abdominal ring with the round ligament; and others proceed to the inguinal glands.

SECTION II.

Of the Absorbents of the Abdomen and Thorax.

The Absorbents of the lower portions of the parietes of the Abdomen and Pelvis unite into trunks that follow the epigastric, the circumflex and the iliac, as well as the lumbar and sacral arteries, &c. They proceed to some of the glands which are in the groin; or in the external iliac, the hypogastric, or some of the contiguous plexuses.

The Absorbents of the Womb are extremely numerous; and, in the gravid state, are very large. Those which are on the neck and anterior part of the body accompany the spermatic vessels.

The Absorbents of the Bladder pass to small glands on its lateral and inferior parts, and finally join the hypogastric plexus.

The Absorbents of the Rectum are of considerable size. They pass through glands that lie upon that intestine, and unite with the lumbar plexus.

The Absorbents of the Kidney are superficial and deep-seated. They are very numerous, but, in a healthy state of the parts, are discovered with difficulty. Cruikshank describes them as they appeared, filled with blood, in consequence of pressing upon the kidney when its veins were full of blood. Mascagni did not inject the superficial vessels with mercury; but describes them as they appeared when filled with colourless size, after he had injected the blood vessels of the organ with the coloured fluid.—The deep-seated absorbents pass out of the fissure of the kidney with the blood vessels, and unite with the superficial; they proceed to the lumbar plexus, and pass into different glands.

Absorbent vessels can be proved to proceed from the pelvis of the kidney, and the ureters, by orifices analogous to those above mentioned.

The Glandulæ Renales are also supplied with absorbents, which are numerous in proportion to the size of the organs. They commonly join those of the kidney.

The Absorbents of the Intestines

Have generally been called LACTEALS, from the white colour of the chyle which they contain: but there seems no reason for believing that they are different in their structure and nature from the absorbents in other parts of the body. A small number of them appear as if they formed a part of the structure of the intestines, and originated from their external surface, as they do in other parts of the abdomen; while the principal part of them are appropriated to the absorption of the contents of the cavity of the intestines.

The first mentioned absorbents run between the muscular and peritoneal coats, and proceed for some distance lengthways on the intestine, while the others proceed for some distance within the muscular coat, with the arteries; and, after passing through it, continue between the lamina of the mesentery.

Branches of these different absorbents are frequently united in one trunk, so as to prove that there is no essential difference between them.

The absorbents which come from the internal surface of the intestines commence in the villi. The manner in which they originate has been the subject of considerable inquiry, as has been stated in the account of the intestines.*

The lacteals or absorbents of the intestines are

* See page 105.

very numerous. They pass between the lamina of the mesentery to *glands* which are also seated between those lamina. The number of these glands is very considerable,* and they are various in size—some being very minute, and others eight or ten lines in diameter. They are generally placed at a small distance from each other, and are most numerous in that part of the mesentery which is nearest to the spine. They are almost always at some distance from the intestines. They appear to be precisely like the absorbent glands in other places.

These absorbent vessels, in their course frequently divide into branches; which sometimes go to the same gland, sometimes to different glands, and sometimes unite with other absorbent vessels. As they proceed, they frequently enlarge in size. When they have arrived near the spine, they frequently form three or four trunks, and sometimes one or two; which proceed in the course of the superior mesenteric artery, until they have arrived near to the aorta. Here they either pass into the thoracic duct, or descend and join the trunks from the inferior extremities, to form the thoracic duct. The absorbents of the great intestines are not equal in size to those of the small; but they are numerous. They enter into glands, which are very near, and, in some places, in contact with the intestine; and are commonly very small in size. The vessels which arise from the cæcum, and the right portion, as well as the arch of the colon, unite with those of the small intestines; while the vessels from the left side of the colon, and the rectum, proceed to the lumbar glands.

The absorbents of the intestines are frequently injected with mercury; but the injection does not proceed to their termination with so much facility as

* They have been estimated between 130 and 150.

it does in other vessels of the same kind. They have, however, very often been seen in animals, who were killed for the purpose after eating milk; and in several human subjects who died suddenly during digestion.—The description of the origin of the lacteals, quoted in page 108, from Mr. Cruikshank, was taken from a subject of this kind, of which an account is given in his work on the absorbent vessels, p. 59.

It is worthy of note, that in several instances, in which the lacteals were thus found distended with chyle, the glands in the mesentery were also uniformly white.

The Absorbents of the Stomach

Are of considerable size, and form three divisions. The vessels of the first set appear upon both sides of the stomach, and pass through a few glands on the small curvature near the omentum minus.—From these glands they proceed to others, which are larger, and which also receive some of the deep-seated absorbents of the liver. The vessels from these glands pass to the thoracic duct, near the origin of the cœliac artery. The second arise also on both sides of the stomach, and pass to the left extremity of the great curvature to unite with the absorbents of that side of the great omentum. They then proceed with the lymphatics of the spleen and pancreas, to the thoracic duct. The last set, pass off from the right extremity of the great curvature, and unite also with absorbents from the right portion of the omentum. They proceed near the pylorus, and go to the thoracic duct, with some of the deep-seated absorbents of the liver.

Although the absorbents of the stomach are deep-seated, as well as superficial, it is a general sentiment, that they do not contain chyle in the human

subject; notwithstanding chyle has been found in the absorbents on the stomach of dogs, and some other animals. It ought, however, to be remembered, that Sabatier has, in some instances, seen white lines on the stomach, which he supposed to be lacteals.

The Absorbents of the Liver

Are especially interesting, because they have been more completely injected than those of any other viscus. They are *deep-seated* and *superficial*. The superficial, it has been already observed, admit of injection in a retrograde direction, and, therefore, can be exhibited most minutely ramified. They communicate freely with each other, and also with the deep-seated vessels, *by their small ramifications;* so that the whole gland has been injected from one large vessel.

The gland is so large, that the absorbents of the superior and inferior surfaces proceed from it in different directions.

A large absorbent is generally found on the suspensory ligament. This is formed by the union of a great many branches that arise both on the right and left lobes, but principally on the right. It often passes through the diaphragm at an interstice which is anterior to the xiphoid cartilage, and then proceeds through glands on the anterior part of the pericardium.

Several absorbents proceed to the lateral ligaments on each side, and then pass through the diaphragm. Some of these branches return again into the abdomen, and the others generally run forwards in the course of the ribs, and join those which pass up from the suspensory ligament. The trunk, or trunks, formed by these vessels, either pass up between the lamina of the mediastinum, and terminate

in the upper part of the thoracic duct; or they accompany the internal mammary arteries, and terminate on the left side in the thoracic duct, and on the right in the trunk of the absorbents of that side.

The *Absorbents on the concave side of the Liver* are as numerous as those on the convex side; they are also very abundant on the surface of the gall-bladder. The greatest part of them join the deep-seated vessels.

The *Deep-seated Absorbents* proceed in considerable numbers from the interior of the liver through the portæ. They accompany the biliary ducts and the great blood vessels of the organ; and, after passing through several glands, near the vena portarum, terminate in the thoracic duct, near the commencement of the superior mesenteric artery.

Mascagni states, that the absorbents of the liver will be distended, by injecting warm water into the biliary ducts, or the vena portarum.

He also observes, that in those preparations in which the superficial vessels are completely injected, in the retrograde direction, the peritoneal coat of the liver appears to be composed entirely of absorbent vessels; and to be connected to the membrane within, by many filaments, which are also absorbent vessels.

The Absorbents of the Spleen

Are composed of superficial and deep-seated vessels; but they differ greatly from those of the liver, in this respect, that the *superficial vessels* are remarkably small in the human subject.

Mascagni, however, asserts, that when the blood vessels of the spleen are injected with size, coloured with vermilion, these absorbents will be filled with colourless size.

In the spleen of the calf the superficial absorbents are remarkably large.

In the human subject the superficial absorbents of the spleen proceed from the convex to the concave surface, and there communicate with the deep-seated absorbents, which proceed from the interior of the organ with the blood vessels.

These *Deep-seated Absorbents* are very numerous, and also large. They accompany the splenic artery; and in their course pass through many glands, some of which are said to be of a dark colour. The glands lie on the splenic artery, at a short distance from each other. The absorbents of the spleen receive the absorbents of the pancreas in their course; they unite with the absorbents of the stomach and the lower surface of the liver, and pass with them to the thoracic duct.

Little has been latterly said by practical anatomists respecting

The Absorbents of the Pancreas.

Mr. Cruikshank once injected them in the retrograde direction; he found that they came out of the lobes of the pancreas in short branches like the blood vessels, and passed at right angles into the absorbents of the spleen, as they accompanied the artery in the groove of the pancreas.

*THE THORACIC DUCT,**

Or common trunk of the absorbent system, is formed by the union of those absorbent vessels which are collected on the lumbar vertebræ.

These vessels, as it has been already observed, are derived from various sources, viz.

The Lower Extremities; the lower part of the Trunk of the Body; the Organs of Generation; the

* First discovered by Eustachius in the horse, 1564; but he considered it a vein for the nourishment of the thoracic viscera.—Ed.

Intestines, with the other Viscera of the abdomen and Pelvis, except a part of the liver. Their number is proportioned to the extent of their origin: for, with the numerous glands appropriated to them, they form the largest absorbent plexus in the body, and are spread over a considerable portion of the aorta and the vena cava.

The manner in which these vessels unite to form the thoracic duct, is very different in different subjects; but in a majority of cases it originates immediately from three vessels, two of which are the trunks of the absorbents of the lower extremities, and the other is the common trunk of the lacteals and the other absorbents of the intestines.

These vessels generally unite on the second or third lumbar vertebræ; and, in some instances, the trunk which they form dilates considerably, soon after its commencement; in consequence of which it was formerly called the *RECEPTACLE of the CHYLE*. At first it lies behind the aorta, but it soon inclines to the right of it, so as to be behind the right crus of the diaphragm. In the thorax, it appears on the front of the spine, between the aorta and the vena azygos, and continues between these vessels until it has arrived at the fourth or third dorsal vertebra. It then inclines to the left, and proceeds in that direction until it emerges from the thorax, and has arisen above the left pleura, when it continues to ascend behind the internal jugular, nearly as high as the sixth cervical vertebra: it then turns downward and forward, and after descending from six to ten lines, terminates in the back part of the angle formed by the union of the left internal jugular with the left subclavian vein. Sometimes, after rising out of the thorax, it divides into two branches, which unite before they terminate. Sometimes it divides, and one of the branches terminates

at the above mentioned angle, and the other in the subclavian vein, to the left of it.

The orifice of the thoracic duct has two valves, which effectually prevent the passage of blood into it from the vena cava.

There are sometimes slight flexures in the course of the duct; but it generally inclines to the left, in the upper part of the thorax, as above mentioned; and is then so near the left lamen of the mediastinum that, if it be filled with coloured injection, it can be seen through that membrane, when the left lung is raised up and pressed to the right.

The duct sometimes varies considerably in its diameter in different parts of its course. About the middle of the thorax it has often been found very small. In these cases it generally enlarges in its progress upwards, and is often three lines in diameter, in its upper part. Many anatomists have observed it to divide and to unite again, about the middle of the thorax.

Absorbents of the Lungs.

The absorbents of the lungs are very numerous, and, like those of other viscera, are superficial and deep-seated.

The large superficial vessels run in the interstices between the lobuli, and, therefore, form angular figures of considerable size. In successful injections, the vacancies within these figures are filled up with small vessels, and the whole surface appears minutely injected.

Mascagni observes, that the superficial vessels are very visible when any fluid has been effused into the cavity of the thorax; or when warm water is injected, either into the blood vessels of the lungs, or the ramifications of the trachea. Cruikshank demonstrated

them by inflating the lungs of a still-born child; in which case the air passes rapidly into them.

The deep-seated absorbents accompany the blood vessels and the ramifications of the bronchiæ. They pass to the dark-coloured glands, which are situated on the trachea at its bifurcation; and on those portions of the bronchiæ which are exterior to the lungs. The injection of the absorbents, which pass to and from these glands, seems to prove that they are of the same nature with the absorbent glands in general, notwithstanding their colour. They are numerous, and they vary in size; from a diameter of two lines to that of eight or ten.

From these glands, *some of the absorbents of the left lung* pass into the thoracic duct, while it is in the thorax, behind the bifurcation of the trachea; others proceed upwards and enter into it near its termination; while those of the right lung terminate in the common trunk of the absorbents of the right side.

CHAPTER II.

OF THE ABSORBENTS OF THE HEAD AND NECK; OF THE UPPER EXTREMITIES, AND THE UPPER PART OF THE TRUNK OF THE BODY.

The absorbents from the various parts of the head pass through glands, which are situated on the neck or the lower part of the head. Those on the head are the least numerous, and also the least in size.—Some of them, which are generally small, lie about the parotid gland. Several of them, which are also small, are on the occiput, below and behind the mastoid process. Sometimes there are two or three on the cheek, near the basis of the lower jaw, about the anterior edge of the masseter muscle. Below the lower jaw, in contact with the sub-maxillary gland and anterior to it, there are always a number of these glands, which are generally small, but often swelled during infancy.

The Glands on the Neck are the most numerous. Many of them are within the sterno-mastoid muscle, and accompany the internal jugular vein and the carotid artery down to the first rib. Many also lie in the triangular space between the sterno-mastoid muscle, the trapezius, and the clavicle; therefore it has been truly said that the glands of the neck are more numerous than those of any other part except the mesentery. They are frequently called *Glandulæ Concatenatæ.* It has already been mentioned that the various absorbents, which are connected with these glands, unite on each side into a trunk, which on the left passes into the thoracic duct, and on the right into the common trunk of the absorbents of that side.

SECTION I.

Of the Absorbents of the Head and Neck.

There is the greatest reason to believe that the brain and its appendages are supplied with absorbents like the other parts. Some of these vessels have been discovered in the cavity of the cranium; but very little precise information has as yet been obtained, respecting the extent, or arrangement of the absorbent system, in this part of the body.

The absorbents on the exterior of the head are as numerous as in other parts of the body. On the occiput they pass down, inclining towards the ear, and continue behind it to the side of the neck; behind the ear they pass through several glands.—From the middle or temporal region of the cranium, they pass with the carotid artery before the ear, and enter some small glands that lie on the parotid; from which they continue to the neck.

They are on every part of the face, and unite, so that their principal trunks, which are very numerous, pass over the basis of the lower jaw, near the facial artery. They enter into glands, which are also very numerous, immediately under the jaw, or which are sometimes to be found on the cheek, at the anterior edge of the masseter muscle. All the absorbents of the exterior part of the head pass to the glands on the side of the neck, already described.

Those from the interior of the nose accompany the ramifications of the internal maxillary artery, and proceed to glands behind the angle of the lower jaw; into which glands also enter the absorbents of the tongue and inner parts of the mouth.

The absorbents of the thyroid gland, on the left side, pass down to the thoracic duct; those on the right, unite to the trunk of the absorbents on that

side, near its termination. It has been remarked, that they can be readily injected, by thrusting the pipe into the substance of the gland.

SECTION II.

Of the Absorbents of the Arm and Upper Part of the Trunk.

The absorbents of the arm are superficial and deep-seated, like those of the lower extremity.

The *superficial absorbents* have been injected on the anterior and posterior surfaces of the fingers and the thumb, near their sides. On the back of the hand they are very numerous, and increase considerably in their progress up the fore-arm. As they proceed upwards, they incline towards the anterior surface of the fore-arm; so that by the time they have arrived at the elbow, almost all of them are on the anterior surface. The absorbents on the anterior part of the hand are not so numerous as those on the back. Sometimes there are digital branches from the fingers, and an arcus in the palm; but this bow is not formed by one large absorbent, analogous to the ulnar artery. On the contrary, its two extremities are continued over the wrist, and pass on the fore-arm like the absorbents.

At the elbow some of them often pass into one or two small glands, which are very superficial; but the whole of the absorbents, somewhat reduced in number, as some of them unite together, pass along with the blood vessels into the hollow of the arm-pit, where they enter the axillary glands. There are generally one or more vessels which pass in the course of the cephalic vein, between the pectoral and the deltoid muscle, and enter into some of the glands under the clavicle.

There are almost always several glands in and near the axilla. Some of them are very near the great blood vessels; sometimes one or more of them are much lower; sometimes they are to be found under the pectoral muscle. They are commonly not so large as those of the groin, and are surrounded with fat.

The deep-seated absorbents originate also at the fingers, and soon accompany the branches of the arteries. Those which attend the radial artery, originate on the back of the hand, and also in the palm, where they are associated with the arcus profundus. They go up with the radial artery to the elbow, and sometimes pass through a small gland about the middle of the fore-arm.

Those which attend the ulnar artery, commence under the aponeurosis palmaris, and go with the artery to the elbow; at the bend of the elbow they are generally joined by one or more, which accompany the interosseal artery; there they unite, so as to form several trunks, which pass up to the axillary with the humeral artery. They sometimes pass through one or two glands, which are near the elbow; and they receive in their course, deep-seated branches from the muscles on the humerus.

The absorbents from the anterior and external part of the thorax, and the upper part of the abdomen, also proceed to the axilla, and enter into the glands there; those which are deep-seated, joining the deep-seated vessels. The absorbents of the mammæ pass to the same glands; and when they are affected with the virus of cancer, can often be perceived, in their course, in the living subject.

The absorbents of the uppermost half of the back, and those of the back of the neck, go likewise to the axilla.

The absorbent vessels, collected from these vari-

ous sources, proceed from the exterior to the innermost glands, but with a considerable diminution of their number: they accompany the subclavian vein, and are reduced to one or two trunks, that generally unite before their termination. On the *left side*, the absorbents of the head and neck generally open into the thoracic duct, as has been already observed; and those of the left arm also open into the thoracic duct, or into the subclavian vein very near it. On the *right side* the absorbents from each of these parts empty into the common trunk, which often is formed by the union of large vessels, from four sources; namely, the head, the thyroid gland, the right arm, and the right cavity of the thorax, &c. The diameter of the trunk is very considerable; but it is often not more than half an inch in length. It generally opens into the right subclavian vein, at the place where it unites to the right internal jugular.

Two respectable physiologists of Europe, (M. Seguin, of Paris, and the late Dr. Currie, of Liverpool,) have doubted whether absorption takes place on the external surface of the skin.* This question has been examined in a very interesting manner by several graduates of the University of Pennsylvania, who chose it for the subject of their inaugural theses; namely, Drs. Rousseau, Klapp, Daingerfield, Mussey, and J. Bradner Stewart.

The three first of these gentlemen state that when spirit of turpentine, and several other substances which are commonly supposed to be absorbed by the skin, were applied to it in a way which prevented their volatile parts

* I believe that M. Seguin's Memoir on this subject was read to the Academy of Sciences a short time before the meetings of that body were suspended. It was published by M. Fourcroy, in La Medicine Eclairée par les Sciences Physiques, vol. iii. An extract from M. Fourcroy's publication may be seen in the 19th chapter of the first volume of Dr. Currie's "Medical Reports on the Effects of Water," &c. in which is also contained a statement of the Doctor's own experiments and reflections.

from entering the lungs by respiration, no absorption took place. But when the inspired air was impregnated with exhalations from these substances, they perceived satisfactory proofs that the exhalations entered the system. From these facts they inferred that when those articles entered the body by absorption, they were taken in by the lungs, and not by the external surface.

On the other hand, the two gentlemen last mentioned, state that after immersing themselves in a bath consisting of a decoction of rhubarb, of madder, or of turmeric, their urine became tinged with these substances. They also assert that the colouring matter of these different articles is not volatile; and, therefore, could not have entered the lungs during the experiments.*

The statement in page 374, from Dr. Soemmering, that when mercury is injected backwards in the absorbent vessels which originate on the foot, it will sometimes appear in small globules on the skin of the foot, has an important connexion with this subject.†

About the middle of the last century, it was generally believed by anatomists, that absorption was performed by the veins. This doctrine seemed to be established by the experiments of Kaaw Boerhaave, which are related, with many other interesting statements, in his work, entitled "Perspiratio Dicta Hippocrati," &c. published at Leyden, in 1738. In these experiments it appeared to the author, that when the stomach of a dog was emptied of its contents, and filled with warm water, immediately after death, the water passed into the minute ramifications of the veins of the

* The Thesis of Dr. Rousseau was published in 1800. Those of Drs. Klapp and Daingerfield in 1805. Dr. Mussey published in the Third Supplement to the Medical and Physical Journal of Dr. Barton, in 1809. Dr. Stewart published in 1810. Additional Observations by Drs. Klapp, Rosseau and Smith, are published in the Philadelphia Medical Museum, vol. i. new series.

† Since the publication of the first volume, the author has enjoyed the advantage of consulting a translation, in manuscript, of some parts of the German edition of Dr. Soemmering's valuable work on the Structure of the Human Body.

stomach, and from them to the vena portarum, and ultimately to the heart in large quantities.

This account appears to be disproved by some experiments of the late John Hunter, made about twenty years after, and published in the Medical Commentaries of Dr. William Hunter, part I.—Mr. Hunter's experiments have been considered as establishing the fact, that absorption, (in the intestines at least,) is performed exclusively by the lacteals, or proper absorbent vessels, and not at all by the veins. Kaaw Boerhaave is of course supposed to have been mistaken; and Mascagni, who has repeated his experiment, refers the appearance of water in the veins to transudations through the coats of the intestines; which he has observed to take place in a great degree.

In the year 1809, a memoir was presented to the national institute of France by Messrs. Magendie and Delile, which contains an account of some experiments that have an important relation to the above mentioned subject.*—The authors being greatly surprised at the rapidity with which the poison of Java, &c. appeared to enter the sanguiferous system, instituted a series of experiments to determine whether these substances proceeded to that system by the circuitous route of the absorbent vessels, or by the shorter course of the veins. Two of their experiments are especially interesting. They made an incision through the parietes of the abdomen of a living dog, who had eaten a large quantity of meat some hours before, (that his lacteals might be visible from their distention with chyle,) and drawing out a portion of the small intestine, they applied two ligatures to it, at the distance of five inches from each other. The portion of intestine between these ligatures was then separated by incision from the rest of the intestinal tube, and all the lacteals, blood vessels, &c. which passed to and from it, were divided, except one artery and a vein. A considerable length of this artery and vein were detached from all the surrounding parts, so that the authors supposed these

* The title of the paper is a "Memoir on the Organs of Absorption in Mammiferous Animals." A translation of it was published in the Medical and Philosophical Register of New York, and in several other periodical works.

vessels to form the only connexion between the portion of the intestine, and the rest of the body. Into the cavity of the intestine, which was thus circumstanced, they introduced a small quantity of the poison, and, to their astonishment, it produced its fatal effects in the same manner it would have done if it had been introduced into the intestine while all its connexions with the body were entire. This experiment, they assert, was repeated several times, without any difference in the result.

After several other experiments, they finally separated the thigh from the body of a living dog in such a manner that the crural artery and vein were left undivided. A quill was then introduced into the artery, and two ligatures were applied to fix it round the quill. The artery was then divided between the two ligatures. The vein was managed in the same manner. There was, therefore, no communication between the limb and the body, except by the blood which passed through the divided vessels and the quills. The poison was then introduced under the skin of the foot, and soon occasioned the death of the animal; its deleterious effects commencing about four minutes after its application to the foot. This experiment appears to prove decidedly that the blood is the vehicle by which poison, when applied to the extremities, is carried to the body; although it may not determine the question whether this poison was taken up by the absorbents or by the veins.*

Some other experiments made by the authors gave results, which are very difficult indeed to explain. They wished to know if the blood of an animal thus contaminated, would produce similar effects upon another animal; and, with a view to ascertain this point, they insinuated a small piece of wood, covered with the poison, into the thick part of the left side of the nose of a dog. Three minutes after the introduction of the poison, they transfused blood from the jugular vein of the same side, into one of the veins of another dog. About one minute after the commencement of the transfusion, the effects of the poison began in the dog

* This experiment has been repeated in Philadelphia. See Professor Chapman's Medical and Physical Journal for February, 1823, No. 10.—Ed.

to which it was applied, and continued until his death. Transfusion into the veins of the other dog went on during the whole time, and he received a large quantity of blood from the dying dog, without producing any effect. They varied this experiment in the following manner. The thigh of a dog was separated from the body; the artery and the vein were arranged as in the former experiment; and poison was introduced into the foot. Three minutes after the introduction of the poison the blood of the crural vein was passed into the jugular vein of another animal and transfusion was continued five minutes without producing any effect upon the animal receiving the blood; it was then stopped, and the crural vein was so arranged that the blood flowed from it into the animal to which it belonged. This animal very soon exhibited symptoms of the operation of the poison.*

From these very interesting experiments the authors infer that "*foreign matters do not always proceed through the Lymphatic or Absorbent Vessels, when they enter into the Sanguiferous system.*"

This memoir was referred by the Institute to four of its members, who are particularly distinguished by their profound knowledge of anatomy and physiology. These gentlemen, after stating their belief that the functions of the lymphatic or absorbent system have been completely ascertained by the experiments and observations of Hunter, Cruikshank, Mascagni, &c. say farther, that in their opinion, the above mentioned inference ought to be a little modified, and that facts are not sufficiently numerous, or applicable to the point in question, to justify the inference that *foreign matters do not always proceed through the Lymphatic or Absorbent Vessels, when they enter the Sanguiferous system.* But they also add, that, as the author is still engaged in a series of experiments on the subject, they will suspend their judgment respecting the inferences to be deduced from the present statement.

* An account of these experiments was published by M. Magendie in a pamphlet. A statement of them is also contained in the report made to the Institute by the committee to whom the memoir was referred, which is published in the Journal de Physique, for March 1813. In that statement this last mentioned experiment is omitted.

A most interesting series of inquiries and experiments in regard to the laws of absorption will be found in Professor Chapman's Journal of the

The most extensive account of the absorbent system is contained in the "Historia et Ichnographia Vasorum Lymphaticorum Corporis Humani" of Mascagni,—"The Anatomy of the Absorbing Vessels of the Human Body, by W. Cruikshank;"—and "The Description of the Lymphatic System, by Wm. Hewson," (the second volume of his Experimental Inquiries,)—are also very interesting publications.

Medical and Physical Sciences, No. 6, in a report of a Committee of the Academy of Medicine, signed by Doctors Lawrance and Coates, of this city.—And a continuation of the same will be found in No. 10, of the same Journal, signed by Doctors Lawrance and Coates. Since the publication of the latter, to the regret of all who knew him, and to the great loss of Anatomy and of Physiology, the indefatigable and excellent LAWRANCE is no more.—ED.

APPENDIX.

OF THE BLOOD.

The blood of a healthy person indicates a tendency to coagulate very soon after it is discharged from the vessels which naturally contain it, although it is perfectly fluid in those vessels.

If it remain at rest, after it is drawn from the vessels, it soon coagulates into a solid mass, of a soft texture. From this solid mass a fluid is soon observed to issue, which first appears in very small drops on almost every part of the surface. These drops quickly increase and run together, and in a short time the fluid surrounds the solid mass, and exceeds it in quantity.

The solid part which thus appears upon the spontaneous separation of the blood, is denominated *Crassamentum* or *Cruror;* the fluid part is called *Serum.*

The substance which contains the red colour of the blood, remains with the *Crassamentum.* The *Serum,* when it separates without agitation, is free from the red colour.

The colouring matter may be separated completely from the *Crassamentum* by washing it with water.

The blood, therefore, consists of three parts, namely, the *Serum;* the *Substance which coagulates spontaneously;* and *the Colouring Matter.*

THE SERUM

Has a considerable degree of consistence, although it is much thinner than blood. In its perfectly natural state, it is almost transparent, and appears to be very lightly tinged with a greenish yellow colour; but it is very often impregnated with a portion of bile, which is probably carried to the blood vessels by the absorbents. It contains a large quantity of albumen, or matter like the white of an egg. If heated to 140° of Fahrenheit, it becomes opaque; and when the heat is increased to 156 or 160, it is firmly coagulated. It is also coagulated by alcohol, by mineral acids, and by rennet.* It is proved by chemists, that it contains a small quantity of pure soda. It therefore changes several of the blue colours of vegetables green. It is also found to contain a similar quantity of the muriate and the phosphate of soda and the phosphate of lime. These saline substances were discovered by diluting serum with water, and exposing the mixture to heat, by which the albumen was coagulated into flocculi; these flocculi were separated by filtration; the liquor was then diminished by evaporation, and the salts obtained from it by crystallization.

Serum likewise contains a portion of sulphur combined with ammonia.

When it is exposed to a coagulating heat, a small portion of it remains fluid.

This fluid portion has been supposed to contain a considerable quantity of gelatine; but it is contended by Mr. Brande,† that *Gelatine* does not exist in

* See Hewson, Vol. I. 139.—I suspect that some particular management is necessary in the use of rennet.

† In his Researches on the Blood communicated to the Royal Society of London, in 1812, and republished in the Eclectic Repertory, for April, 1813.

the serum of the blood, and that this portion consists of albumen combined with a proportion of alkali.

It is also asserted by Dr. Bostock,* one of the latest writers on the subject, that the serosity of the blood, (the term applied to the last mentioned fluid,) contains no gelatine; but that, with a minute quantity of albumen, it consists of a large portion of an animal matter, which is different either from gelatine or albumen, being unlike either of them in its chemical qualities.

THE CRASSAMENTUM

Is rendered very different in its appearance, by the different circumstances in which it may coagulate.

When the blood remains at rest immediately after it is drawn, the crassamentum which forms in it is a concrete substance, without the smallest appearance of fibre in its composition. If the blood is stirred with a rough stick, while it is flowing from an animal, a large portion of it will concrete upon the stick in a fibrous form, so as to resemble a mass of entangled thread, some of the red colouring matter still adhering to it.

The crassamentum, in either of these forms, may be washed perfectly white; the red colouring matter passing completely away with the water. In this state it appears† to have all the chemical properties of the fibrous matter of muscular flesh. It also resembles the gluten of vegetables, being soft and elastic. The name FIBRINE is now generally applied to it.

If FIBRINE is washed and dried, its weight is very

* See his Observations on the Serum of the Blood, in the Medico-Chirurgical Transactions, Vol. II. republished in the Eclectic Repertory, for October, 1812.

† By the experiments of Mr. Charles Hatchett, published in the London Philosophical Transactions for 1800.

small indeed when compared with that of the blood from which it has been obtained. It is, therefore, probable that a considerable proportion of the bulk of the crassamentum, as it forms spontaneously, depends upon the serum which exists in it, and can be washed away.

The spontaneous coagulation of the blood, which appears to depend principally upon the *Fibrine,* may be prevented by the addition of several foreign substances to the blood, when it is drawn. It is subject to great variations that depend upon the state of the body at the time of bleeding; and in some conditions, it does not take place at all.*

In a majority of dead subjects the blood is found more or less coagulated in the veins; but in some subjects it is found without coagulation. It is asserted that it does not coagulate in subjects who have died suddenly, in consequence of anger, lightning, or a blow on the stomach.

THE COLOURING MATTER.

When the blood vessels in the transparent parts of certain livings animals are examined with magnifying glasses, it appears that the red colour of the blood is owing to bodies of a globular form, which are diffused through a transparent fluid. The appearance of these bodies has been examined, with great attention, by many physiologists, since the publication of Leuwenhoeck, in the London Philosophical Transactions.†

* See an Inquiry into the Properties of the Blood, by the late Wm. Hewson: and Experiments by his son, T. T. Hewson, in the Eclectic Repertory, Jan. 1811.—See also a Treatise on the Blood, &c. by the late J. Hunter.

† Among the most distinguished of these observers were Father de la Torre, Haller, Hewson, Fontana, Spalanzani, J. Hunter, Cavallo.

Some short accounts of Leuwenhoeck's original observations on the

Several of these gentlemen have described the appearance of the blood very differently; but Haller, Spalanzani and J. Hunter agree that the figure of the red particles is globular.* Hunter observes farther, that the red globules do not run into each other as two globules of oil would do when divided by water; and he believes that they cannot unite.— At the same time they seem not to have the properties of a solid: for when circulating in the vessels, they assume elliptical forms, adapting themselves to the size of the vessels. They also excite no sensation of solidity when touched.

They appear to be more heavy than the other parts of the crassamentum: for in healthy blood the lower part of the mass contains more of the colouring matter than the upper part; and in the blood of persons who labour under acute local inflammation, they often subside completely from the upper part; and thus occasion what is called by Mr. Hewson, *the inflammatory crust*, or *size*.

It has been observed by Mr. Hewson, and also by Mr. Hunter, that the globules do not retain their form in every fluid. They are said to be dissolved

Blood are to be found in the Philosophical Transactions of London, for 1664, in the fasciculi which are numbered 102 and 106. A more full description is contained in Boerhaave's Academical Lectures on the Theory of Physic. See the section on the nature of the blood.

The glasses of Father de la Torre were transmitted from Naples to the Royal Society of London in 1765. They were accompanied by a letter from Sir F. H. E. Stiles, to which are subjoined some observations by the Rev. Father himself. The letter and the observations are published in the 55th volume of the Transactions of that society.

In the year 1798, Tiberius Cavallo published an Essay on the Medicinal Properties of Factitious Air, with an Appendix on the Nature of the Blood, in which is contained a farther account of the glasses of de la Torre.

* I believe that this is also the opinion of Fontana.—In J. Hunter's work on the blood there are some interesting observations on microscopical deceptions. See the note commencing in page 39, Bradford's edition.

very quickly in water, and then they form a fine clear red. Several of the neutral salts, when dissolved in water, prevent the solution of the globules. Mr. Hunter informs us, that the vitriolic acid, when greatly diluted, does not dissolve them, &c. The muriatic acid, when three times as strong as vinegar, destroys their colour without dissolving them, although when more diluted, it dissolves them.

The colour of the blood has, for a long time, been supposed to depend upon iron. About the middle of the last century, Vicentius Menghini published in the Transactions of the Academy of Sciences of Bologna, an account of experiments which contributed to establish this sentiment. In this account he stated that, after washing the colouring matter from the crassamentum, he had separated it from the water by boiling; in which case it either rose to the surface of the water, or subsided, and left the water clear. After drying, with a gentle heat, some of the colouring matter thus separated, and then repeatedly washing it, he found that it contained a considerable quantity of iron, which was attracted by the magnet.

After exposing a large quantity of the colouring matter to an intense heat, he found in it a small piece of iron, of a spherical form, but hollow; and a powder which was attracted by the magnet, but appeared more like rust of iron than iron filings.

He believes the seat of this iron to be in the colouring matter of the blood, as neither the serum nor fibrine appeared to contain it. According to his calculation, the blood of a healthy man contains more than two ounces of iron.

This doctrine of Menghini has been very generally admitted: and several chemists of the first character, namely, Bucquet, Fourcroy, Vauquelin, &c.

have made experiments to ascertain the substances with which the iron in the blood is combined.

But within a few years, doubts have been expressed on this subject by several physiologists, and especially by Dr. Wells, and Mr. Brande.

The first of these gentlemen, in his "*Observations and Experiments on the Colour of the Blood,*" published in the London Philosophical Transactions for 1797, states three reasons for rejecting the opinion that the colour of the blood is derived from iron.

1. The colour of blood is destroyed by a heat less than that of boiling water; whereas no colour arising from a metal is destroyed by exposing it, subject, in a close vessel, to such a heat.

2. If the colour from a metal, in any substance, be destroyed by any alkali, it may be restored by the immediate addition of an acid; and the like will happen by the addition of a proper quantity of an alkali, if the colour has been destroyed by an acid.—The colour of blood, on the contrary, when once destroyed, can never be brought back, either by an acid or an alkali.

3. If iron be the cause of the red colour of blood, it must exist there in a saline state; since the red matter is soluble in water. The substances, therefore, which detect the smallest quantity of iron in such a state, ought likewise to demonstrate its presence in blood; but upon adding Prussian alkali, and an infusion of galls, to a very saturated solution of the red matter, he could not observe "in the former case the slightest blue precipitate; or in the latter that the mixture had acquired the least blue or purple tint."

Mr. Brande, in a paper entitled "*Chemical Researches on the Blood,*" &c., communicated to the Royal Society of London in 1812, relates many experiments which were made on the colouring matter of

that fluid, with acids, alkalies, astringents, &c. &c. From these experiments, he also infers, that the *colouring matter of the blood is perfectly independent of iron.*

In support of this inference, he adds, that the Armenian dyers, in the preparation of their finest and most durable red colours, use blood in addition to madder, in order to ensure the permanency of these colours. As the compounds of iron convert the colour of madder to gray and black, the production of a bright colour by the addition of blood to madder, he regards as a proof, that *iron* is not the colouring matter of blood.

Many estimates have been made of the quantity of blood in the human body; but some of the best informed physiologists have regarded them as fallacious.

STRUCTURE OF GLANDS.

Any *original* structure that discharges from the blood vessels a fluid different from those which they naturally contain, may be considered as glandular. The function or process by which such fluids are derived from the blood vessels is called *secretion.*

A structure of this kind seems to exist in very different situations: for it is distinctly circumscribed in many of those bodies commonly denominated glands, which are of a very precise form; and it is also diffused on some very extensive surfaces. The gastric liquor, a most important secretion, is probably discharged from vessels which open, like exhalents, on the internal surface of the stomach; and not from any circumscribed bodies, which are generally denominated *Glands.*

The name of gland is theoretically applied to

several bodies which cannot be proved to secrete any fluid whatever; and also to those bodies connected with the absorbent vessels, which are called the *Lymphatic Glands;* but it is most commonly appropriated to those organs which *discharge* a fluid different from the blood.

The structure by which mucus is secreted in some places, appears to be very simple. Thus, in the Schneiderian membrane and the urethra, there are small ducts from four to six lines in length, and equal in diameter to a bristle, which appear to be formed of the membrane on which they open. From these ducts mucus issues to cover the surfaces of these membranes. In many instances there is no substance resembling that of the circumscribed glandular bodies, connected with these ducts; but the secreted fluid seems to be discharged into the ducts from the small vessels on their surfaces. The ducts of this nature in the urethra are denominated *Lacunæ.*

In some other parts of the body, the cavities into which mucus is discharged are somewhat different, both in form and size, from those above mentioned, and are called *Follicles.* These cavities are surrounded with more or less of a pulpy vascular substance, which has been considered as glandular, and essential to the mucous secretion.

The circumscribed bodies, which are commonly called glands, differ in their internal appearance and texture, from the other parts of animals. The substance of which they consist differs very much in the different glands; and thus renders the liver, kidneys, salivary glands, mammæ, &c., very different from each other. Some glands, as the salivary, &c., are composed of several series of lobuli that successively diminish. The smallest of these are denominated *Acini.* Each of them is connected by a small artery

and vein, to the large blood vessels of the glands; and also sends a branch to join the excretory duct.

These *Acini* are therefore connected to each other, by the blood vessels and excretory duct of the gland, and also by the cellular membrane which covers them externally, and occasions them to adhere to each other where they are in contact. In consequence of this structure, these glands have a granulated appearance.

The liver, when incised with a sharp instrument, appears differently; but when broken into pieces, it seems to consist of small acini. Some other glands, as the *Prostate*, appear to be uniform in their texture, and have none of this granulated appearance.

The structure of glands has long been an interesting object of anatomical inquiry, and was investigated with great assiduity by those eminent anatomists, Malpighi and Ruysch.

Malpighi, as was formerly observed, used ink and other coloured fluids in his injections. He was also very skilful in the use of microscopes, and took great pains in macerating and preparing the subjects of his inquiries. Ruysch, on the other hand, used a ceraceous injection, and was most eminently successful in filling very small vessels with it. Malpighi believed that there were follicles or cavities in glandular bodies, which existed between the extremities of the arteries and the commencement of the excretory ducts of those bodies, and that in these cavities the secreted fluids underwent a change.—Ruysch contended, that the arteries of glands were continued into excretory ducts, without the intervention of any cavity or follicle; that the small bodies which had been supposed to contain follicles or cripæ, were formed by convolutions of vessels, and that the change of the fluid, or the process of secretion, is produced by the minute ramifications of the artery.

A very interesting account of this subject is contained in two celebrated letters, which passed between Boerhaave and Ruysch in the year 1721, and are published at the end of the fourth volume of the works of Ruysch.

The opinion of Ruysch has been most generally adopted by anatomists, and has derived support and confirmation from several anatomists since his time. The late Mr. Hewson declared his conviction that the small globular bodies which are scattered through the kidneys, and were supposed to be follicles or criptæ, are merely convoluted arteries. He also asserted, that the acini which appeared in the mammæ as large as the heads of pins, when the excretory ducts of that gland were injected with vermilion and painters' size, proved to be the minute ramifications of the excretory duct, which divided very suddenly into branches so small, that they could not readily be seen by the naked eye.*

Notwithstanding these reasons for supposing that the excretory ducts of glands were derived simply from the arteries of those bodies, it is said that the late Dr. W. Hunter used to declare his belief, that there was a part in glands which was not injected in his preparations; and to say farther, that he believed his preparations were injected as minutely as those of Ruysch.

All of these opinions have been strenuously controverted by the Italian anatomist, Mascagni, who believes that the arteries terminate only in veins; and of course that they neither form exhalent vessels, nor communicate with the excretory ducts of glands. His idea of the structure of glands is different from those either of Malpighi or of Ruysch.

* See Experimental Inquiries, vol. ii. p. 178.

He supposes that glands contain a great number of minute cells; that the arteries, veins, and absorbent vessels are spread upon the surfaces of these cells, in great numbers, and very irregularly. From these cells very small canals originate, which unite to form the small branches of the excretory ducts. According to his idea, the secreted fluid is discharged through pores or orifices of the blood vessels, into the cells, and proceeds from them through the canals, into the branches of the excretory ducts. Absorbent vessels, in great numbers, originate from these cells.

In his great work on the absorbent system, when treating on the termination of arteries and the commencement of veins, (Part I. Section 2.) he asserts, that if the kidneys are successfully injected with size, coloured with vermilion, and then laid open by a section of a razor, it will be found that the size without the colour has passed into cells which are very numerous; that the arteries and veins are ramified most minutely on the surfaces of these cells, and that the tubuli uriniferi, as well as the absorbent vessels, originate from them.

He supposes that a considerable portion of the fluid thus passing off from the blood vessels, is commonly taken up by the absorbent vessels of the kidneys: for in two cases in which he found the absorbent vessels obstructed, a diabetis existed, which he considered as the effect of the inactivity of the absorbents. He asserts, that in the liver, pancreas, mammæ, and also in the salivary and lachrymal glands, the minute arteries and veins are also distributed upon the surfaces of cells; and that very small canals arise from these cells, and unite to form the small branches of the excretory ducts.

This great anatomist appears to have been much

occupied with microscopial observations, and has gone largely into the discussion of this subject.*

It must, however, be acknowledged, that no information which has as yet been obtained respecting the structure of glands, enables us to explain their wonderful effect upon the fluids which pass through them. It remains yet to be ascertained why one structure forms saliva and another bile; or why so much apparatus should be necessary for the secretion of milk when adipose matter appears to be produced by the mere membrane in which it is contained.

Dr. Berzelius, professor of Chemistry at Stockholm, in a late work on animal chemistry, asserts, that if all the nerves going to a secretory organ are divided, secretion will cease, notwithstanding the continued circulation of the blood. From this, he thinks, that secretions depend upon the influence of nerves, although he cannot explain their effects.

Mr. Home, after relating some experiments upon blood and serum, made with the Voltaic Battery, proposes the following questions, among others:—Whether a weaker power of electricity than any which can be kept up by art, may be capable of separating from the blood the different parts of which it is composed; and forming new combinations of the parts so separated? Whether the structure of the nerves may enable them to possess a low electrical power, which can be employed for that purpose? &c.

See the London Philosophical Transactions, for 1809, part II.†

*The late Dr. W. Hunter, in his Medical Commentaries, (p. 40,) avowed his belief, that the fluids which appear occasionally in the various cavities of the body, transude through the coats of the blood vessels. Mr. Hewson, (Experimental Inquiries, Vol. II. Chap. 7.) suggested several reasons for dissenting from this opinion; but Mascagni has endeavoured to support it.—See a long note to the above mentioned section of this work, page 74.

† Mr. Wollaston has also published a small paper on this subject, in the Philosophical Magazine, Vol. 33.

GLOSSARY,*

EXHIBITING THE DERIVATION OF CERTAIN ANATOMICAL TERMS.

A

ACETABULUM. The cavity which receives the head of the thigh-bone; from *acetum* vinegar; so called, because it represents the acetabulum or saucer of the ancients, in which vinegar was held for the use of the table.

Acini. From *acinus* a grape.

Acromion. A process of the scapula; from ακρος extremity, and ωμος the shoulder.

Anastomosis. The communication of vessels with one another; from ανα through, and στομα mouth.

Anatomy. The dissection of the human body; from ανα and τεμνω to dissect.

Anconeus. A muscle; so called from αγκων the elbow.

Aorta. Αορτη, from αηρ air, τηρειν to keep.

Aponeurosis. A tendinous expansion; from απο, and νευρον a nerve; from an erroneous supposition of the ancients, that it was formed by an expansion of nerve.

Apophysis. A process of a bone; from αποφυω to proceed from. A synonyme of process.

Arachnoides. A net-like membrane; from αραχνη a spider, and ειδος likeness.

Artery. From αηρ air, and τηρειν to keep; because the ancients supposed that air only was contained in them.

Arthrodia. A species of connexion of bones; from αρθροω to articulate.

Arytænoides. The name of two cartilages of the larynx; also applied to some muscles of the larynx; from αρυταινα a funnel, and ειδος a shape.

* By Dr. Hooper.

Astragalus. A bone of the tarsus; so called from its resemblance to a die used in ancient games, from αστραγαλος a cockal or die.

Atlas. The first vertebra of the neck; so called, because it sustains the head; from the fable of Atlas being supposed to have supported the world; or from ατλαω to sustain, because it sustains the head.

Azygos. A term applied to parts without a fellow, from α priv. and ζυγος a yoke, because it has no fellow.

B

Bursa. A bag; from βυρσα: generally applied to the bursæ mucosæ.

C

Cancelli. Lattice work; generally applied to the reticular substance in bones.

Cardia. The superior opening of the stomach; from καρδια the heart.

Carotid. The name of some arteries of the neck and head, from καροω to cause to sleep; for, if tied with a ligature, the animal was said to be affected with coma.

Carpus. Καρπος; the wrist.

Clavicula. The clavicle or collar-bone, a diminutive of *clavis* a key; so called from its resemblance to an ancient key.

Clinoid. Four processes of the sella turcica of the ethmoid bone are so called, from κλινη a bed, and ειδος likeness; from their supposed resemblance to a couch.

Clitoris. A part of the female pudenda; enclosed by the labia majora; from κλειω to enclose or hide.

Colon. The first of the large intestines; from κωλον, quasi κοιλον, from κοιλος hollow.

Coracoid. From κοραξ a crow, and ειδος resemblance; shaped like the beak of a crow.

Coronary, From *corona* a crown. The vessels of the heart, stomach, &c. are so called because they surround the parts in the manner of a crown.

Cotyloid, from κοτυλη the name of an old measure, and ειδος resemblance: resembling the kotule.

Cranium. The skull; κρανιον, quasi, καρανιον from καρα the head.

Cremaster. A muscle so called; from κρεμαω to suspend, because it suspends the testicle.

Cribriform. From *cribrum* a sieve, it being perforated like a sieve.

Cricoid. Annular, round, like a ring; from κρικος a ring, and ειδος likeness.

Cuboides. A bone of the foot; from κυβος a cube, and ειδος likeness; because it resembles a cube.

Cuneiform. Some bones are so called; from *cuneus* a wedge, and *forma* likeness, being shaped like a wedge.

D.

Deltoid. A muscle resembling the Greek letter Δ: from Δ, and ειδος resemblance.

Diaphragm. The muscle which separates the thorax from the abdomen; from διαφραττω to divide.

Diarthrosis. A moveable connexion of bones; from διαρθροω to articulate.

Digastric. From δις twice, and γαστηρ a belly; having two bellies.

Diploe. The spongy substance between the two tables of the skull; from διπλοω to double.

Duodenum. The first portion of the small intestines; so called because the ancients supposed that it did not exceed the breadth of twelve fingers; from *duodenus*, consisting of twelve.

Dura Mater. The outermost membrane of the brain; called *dura*, because it is much harder than the other membranes, and *mater*, from the idea of the ancients that it was the source of all the other membranes.

E.

Embryo. The child in the womb is so called before the fifth month, after which, it is termed *fœtus;* from εμβρυω to bud forth.

Enarthrosis. An articulation of bones; from εν in, and αρθρον a joint or articulation.

Enteric. Belonging to the intestines; from εντερον an entrail or intestine.

Epidermis. The scarf or outermost skin; from επι upon, and δερμις the skin.

Epididymis. The small oblong body which lies above the testicles; from επι upon, and διδυμος a testicle.

Epigastric. The superior part of the abdomen; from επι upon, and γαστηρ the stomach.

Epiglottis. A cartilage of the larynx so called; from επι upon, and γλωττις the aperture of the larynx, being situated upon the glottis.

Epiphysis. A portion of bone growing upon another bone, but separated from it by a cartilage; from επι upon, and φυω to grow.
Epiploon. The membranous viscus of the abdomen, which covers the intestines, and hangs to the bottom of the stomach; from επιπλεω to swim upon.
Ethmoid. From ηθμος a sieve, and ειδος resemblance; being perforated like a sieve.

F.

Fascia. An expansion, enclosing other parts, like a band; from *fascis* a bundle.
Falciform. Shaped like a sithe; from *falx*, a sithe.
Fasciculus. A little bundle, dim. of *fascis* a bundle.
Fauces. The plural of *faux*, the top of the throat.

G.

Ganglion. Γαγγλιον, a knot in the course of a nerve.
Gastrocnemius. The muscle which forms the thick of the leg; from γαστηρ a belly, and κνημη the leg.
Genio. Names compounded with this word belong to muscles which are attached to the chin, as geno-glossus, geno-hyoideus, &c.; from γενειον the chin.
Ginglymus. An articulation; from γιγγλυμος a hinge.
Glenoid cavity. From γληνη a cavity, and ειδος resemblance.
Glosso. Names compounded with this word belong to muscles which are attached to the tongue; as glosso-pharyngeus—glosso-staphilinus, &c.; from γλωσσα the tongue.
Glottis. The superior opening of the larynx at the bottom of the tongue; from γλωττα the tongue.
Glutæus. The name of a muscle; from γλουτος the buttocks.
Gomphosis. Γομφωσις, a species of immoveable connexion of bones; from γομφος a nail, because one bone is fixed in another bone like a nail in a board.

H.

Helix. The outward circle of the ear; from ειλεω to turn about.
Hepar. The liver. Ἡπαρ an abdominal viscus.
Hyaloid. From ὑαλος glass, and ειδος likeness; the capsule of the vitreous humour of the eye is so called, from its transparent and glassy appearance.
Hymen. The membrane situated at the entrance of the virgin vagina; from Ὑμην Hymen, the god of marriage.
Hyoides. A bone of the tongue, so called from its resemblance to the Greek υ; from υ, and ειδος resemblance.

Hypochondrium. That part of the body which lies under the cartilages of the spurious ribs; from ὑπο under, and χονδρος a cartilage.

Hypogastric. The lower region of the fore part of the abdomen; from ὑπο under, and γαστηρ the stomach.

I.

Ileon. A portion of the small intestines; from ειλεω to turn, being always convoluted.

Ischium. The part of the os innominatum upon which we sit; from ισχυω to sustain.

L.

Lacuna. The excretory duct of the glands of the urethra and vagina; from *lacus* a channel.

Lambdoidal suture. So called because it is shaped like the letter Λ; from Λ, and ειδος resemblance.

Larynx. The superior part of the windpipe; λαρυγξ the larynx.

M.

Masseter. A muscle of the face, which assists in the action of chewing; μασσαομαι to chew.

Mastoid. From μαστος a teat, and ειδος likeness; shaped like a nipple or teat.

Mediastinum. The production of the pleura, which divides the thorax into two cavities; from *medium* the middle, *quasi in medio stare.*

Mesentery. The membranes to which the intestines are attached: from μεσος the middle, and εντερον an intestine, because it is in the middle of the intestines.

Mesocolon. That part of the mesentery in the middle of the colon; from μεσος the middle, and κωλον the colon.

Metacarpus. That part of the hand between the carpus and fingers; from μετα after, and καρπος the wrist.

Metatarsus. That part of the foot between the tarsus and toes; from μετα after, and ταρσος the tarsus.

Mylo. Names compounded with this word belong to muscles which are attached near the grinders, as *mylo-hyoideus,* &c.; from μυλη a grinder tooth.

O.

Odontoid. Tooth-like; from οδους a tooth, and ειδος resemblance.

Œsophagus. The canal leading from the pharynx to the stomach; from οιω to carry, and φαγω to eat; because it carries the food into the stomach.

Olecranon. The elbow, or head of the ulna; from ωλενη the cubit, κρανον and the head.

Omentum. An abdominal viscus; so called from *omen* a guess, because the soothsayers prophesied from the inspection of the part.

Omo. Names compounded with this word, belong to muscles which are attached to the scapula, as *omo-hyoideus,* &c. from ωμος the shoulder.

Omoplata. The scapula or shoulder blade; from ωμος the shoulder, and πλατυς broad.

Osteology. The doctrine of the bones; from οστεον a bone, and λογος a discourse.

P.

Pancreas. A viscus of the abdomen; so called from its fleshy consistence; from παν all, and κρεας flesh.

Parenchyma. The substance of some of the viscera was so called, from παρεγχυω to pour through.

Parotid Gland. From παρα near, and ους the ear; because it is situated near the ear.

Pelvis. A bony cavity shaped like a basin; from πελυς a basin.

Pericardium. The membrane which surrounds the heart; from περι around, and καρδια the heart.

Pericranium. The membrane which covers the bones of the skull; from περι around, and κρανιον the cranium or head.

Periosteum. The membrane which surrounds the bones; from περι around, and οστεον a bone.

Peristaltic motion of the intestines; from περιστελλω to contract.

Peritoneum. The membrane lining the abdomen, and covering its viscera; from περιτεινω to extend around.

Phalanx. The bones of the fingers and toes are called phalanxes, from their regular situation, like a φαλαγξ, or arrangement of soldiers.

Pharynx. A membranous bag at the end of the mouth; απο του φερειν because it conveys the food into the stomach.

Phrenic or *diaphragmatic nerve.* φρενες the diaphragm; from φρην the mind; because the ancients supposed it to be the seat of the mind.

Pia Mater. The innermost membrane of the brain, so called because it embraces the brain as a careful mother folds her child.

Pleura. The membrane lining the thorax; πλευρα the side.

Plexus. A kind of net-work of vessels or nerves; from *plecto,* to weave together.

Psoas. A muscle so called; from ψοα the loin, being situated in the loins.

Pterygoid process. From πτερυξ a pen or wing, and ειδος likeness, so called from its likeness to a pen or wing.

Pylorus. The lower orifice of the stomach, which opens into the intestines; from πυλοω to guard an entrance, because it guards as it were the entrance of the bowels.

R.

Raphe. A suture; from ραπτω to sew.

Renes. The kidneys, απο τȣ ρειν, because through them the urine flows.

Retina. The net-like expansion of the optic nerve, on the inner surface of the eye; from *rete* a net.

Rhomboides. A muscle so called from its shape; from ρομβος, a geometrical figure, whose sides are equal, but not right-angled, and ειδος a likeness.

Rotula. The knee-pan; a dim. of *rota* a wheel, from its shape.

S.

Sacrum. A bone so called; from *sacer* a word, because it was once offered in sacrifices.

Salvatella. A vein of the foot, so called because it was thought that opening it preserved health, and cured melancholy; from *salvo* to preserve.

Sanguis. The blood; απο τȣ σωειν γυια, because it preserves the body.

Sartorius. A muscle, so called because tailors cross their legs with it; from *sartor* a tailor.

Scapha. The depression of the outer ear, before the anti-helex; from σκαφη a little boat or skiff.

Scaphoides. A bone of the carpus, so called from its resemblance to a skiff; from σκαφη a skiff, and ειδος likeness.

Sclerotic. A term applied to the outermost or hardest membrane of the eye; from σκληροω to make hard.

Sesamoid bones. From σησαμη a grain, and ειδος likeness; from their resemblance to the semen sesami.

Sigmoid. Parts are so called from their resemblance to the letter Σ; from Σ, the letter Sigma, and ειδος likeness.

Sphenoid. From σφην a wedge, and ειδος likeness; shaped like a wedge.

Sphincter. The name of several muscles, whose office it is to shut up the aperture around which they are placed; from σφιγγω to shut up.

Splanchnic. From σπλαγχνος an entrail.

Symphisis. A connexion of bones; from συμφυω to grow together.

Synarthrosis. A connexion of bones; from συν with, and αρθρον a joint.

Synchondrosis. A species of union of bones by means of cartilage; from συν with, and χονδρος a cartilage.

Synneurosis. A species of connexion of bones by means of membrane; from συν with, and νευρος a nerve; because membranes, ligaments, and tendons, were by the ancients considered as nerves.

Syssarcosis. A species of connexion of bones by means of muscle; from συν with, and σαρξ flesh.

Systole. The contractile motion of the heart and arteries; from συστελλω to contract.

T.

Tendon. From τεινω to extend.

Thorax. Θωραξ. The breast or chest.

Thyroid. From θυρεος, a shield, and ειδος likeness; shaped like a shield.

Trachea. The wind-pipe; so called from its roughness; from τραχυς rough.

Trochanter. A process of the thigh-bone, so called from τροχος a wheel.

U.

Ulna. A name for the cubit; from ωλενη the cubit.

Ureter. The canal which conveys the urine from the kidney to the bladder; from ουρον the urine.

Urethra. The passage through which the urine passes from the bladder; from ουρον the urine.

Uvea. The posterior lamen of the iris, so called because in many animals it is of the colour of unripe grapes; from *uva* an unripe grape.

Uvula. The conical substance which hangs down from the middle of the soft palate; so called from its resemblance to a grape. A dim. of *uva* a grape.

V.

Valves. From *valvæ,* folding doors.

Vertebræ. The bones of the spine are so called; from *verto* to turn.

X.

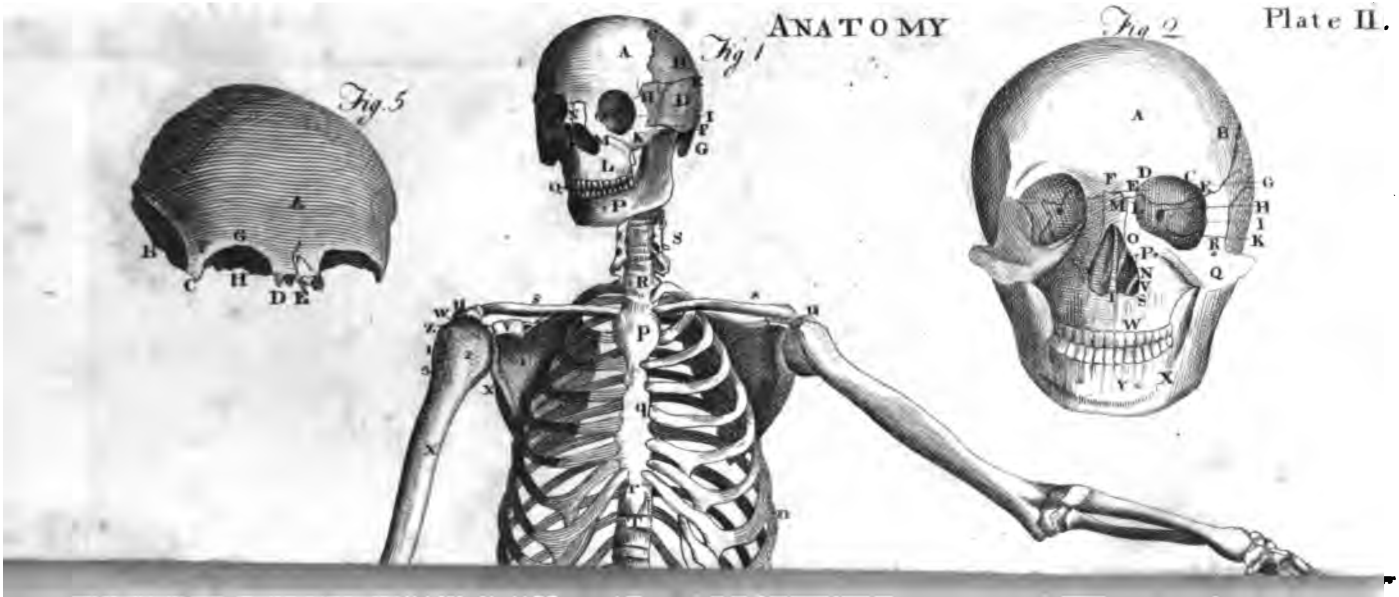
Xiphoid. So called from the resemblance to a sword; from ξιφος a sword, and ειδος likeness.

Z.

Zygoma. The cavity under the zygomatic process of the temporal bones; from ζυγος a yoke.

ALPHABETICAL INDEX TO VOLUME II.

ANATOMY Plate II.



ANATOMICAL PLATES.

EXPLANATION OF THE PLATES OF OSTEOLOGY.

Plate II.

Fig. 1. A Front View of the Male Skeleton.

A, The os frontis. B, The os parietale. C, The coronal suture. D, The squamous part of the temporal bones. E, The squamous suture. F, The zygoma. G, The mastoid process. H, The temporal process of the sphenoid bone. I, The orbit. K, The os malæ. L, The os maxillare superius. M, Its nasal process. N, The ossa nasi. O, The os unguis. P, The maxilla inferior. Q, The teeth, which are sixteen in number in each jaw. R, The seven cervical vertebræ, with their intermediate cartilages. S, Their transverse processes. T, The twelve dorsal vertebræ, with their intermediate cartilages. U, The five lumbar vertebræ. V, Their transverse process. W, The upper part of the os sacrum. X, Its lateral parts. The holes seen on its fore part are the passages of the undermost spinal nerves and small vessels. Opposite to the holes, the marks of the original divisions of the bones are seen. Y, The os ilium. Z, Its crest or spine. a, The anterior spinous processes. b, The brim of the pelvis. c, The ischiatic notch. d, The os ischium. e, Its tuberosity. f, Its spinous process. g, Its crus. h, The foramen thyroideum. i, The os pubis. k, The symphisis pubis. l, The crus pubis. m, The acetabulum. n, The seventh or last true rib. o, The twelfth or last false rib. p, The upper end of the sternum. q, The middle piece. r, The under end, or cartilago ensiformis. s, The clavicle. t, The internal surface of the scapula. u, Its acromion. v, Its coracoid process. w, Its cervix. x, The glenoid cavity. y, The os humeri. z, Its head, which is connected to the glenoid cavity. 1, Its internal tubercle. 2, Its internal tubercle. 3, The groove for lodging the long head of the biceps muscle of the arm. 4, The internal condyle. Be-

tween 4 and 5, the trochlea. 6, The radius. 7, Its head. 8, Its tubercle. 9, The ulna. 10, Its coronoid process. 11, 12, 13, 14, 15, 16, 17, 18; The carpus, composed of the os naviculare, os lunare, os cuneiform, os pisiforme, os trapezium, os trapezoides, os magnum, os unciforme. 19, The five bones of the metacarpus. 20, The two bones of the thumb. 21, The three bones of each of the fingers. 22, The os femoris. 23, Its head. 24, Its cervix. 25, The trochanter major. 26, Trochanter minor. 27, The internal condyle. 28, The external condyle. 29, The rotula. 30, The tibia. 31, Its head. 32, Its tubercle. 33, Its spine. 34, The malleolus internus. 35, The fibula. 36, Its head. 37, The malleolus externus. The tarsus is composed of, 38, The astragalus; 39, The os calcis; 40, The os naviculare; 41, Three ossa, cuneiformia, and the os cuboides, which is not seen in this figure. 42, The five bones of the metatarsus. 43, The two bones of the great toe. 44, The three bones of each of the small toes.

FIG. 2. A Front View of the SKULL.

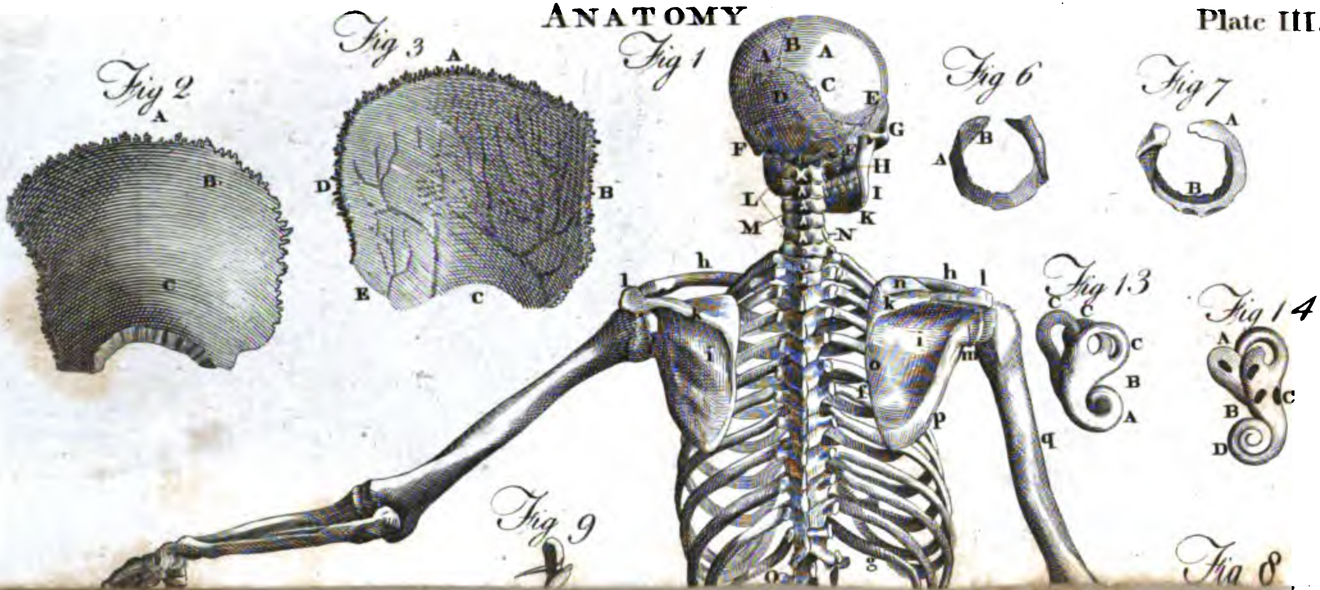
A, The os frontis. B, The lateral part of the os frontis, which gives origin to part of the temporal muscle. C, The superciliary ridge. D, The superciliary hole through which the frontal vessels and nerves pass. EE, The orbitar processes. F, The middle of the transverse suture. G, The upper part of the orbit. H, The foramen opticum. I, The foramen lacerum. K, The inferior orbitar fissure. L, The os unguis. M, The ossa nasi. N, The os maxillare superius. O, Its nasal process. P, The external orbitar hole through which the superior maxillary vessels and nerves pass. Q, The os malæ. R, A passage for small vessels into or out of, the orbit. S, The under part of the left nostril. T, The septum narium. U, The os spongiosum superius. V, The os spongiosum inferius. W, The edge of the alveoli, or spongy sockets for the teeth. X, The maxilla inferior. Y, The passage for the inferior maxillary vessels and nerves.

FIG. 3. A Side-view of the SKULL.

A, The os frontis. B, The coronal suture. C, The os parietale. D, An arched ridge, which gives origin to the temporal muscle. E, The squamous suture. F, The squamous part of the temporal bone; and farther forwards, the temporal process of the sphenoid bone. G, The zygomatic process of the temporal bone. H, The zygomatic suture. I, The mastoid process of the temporal bone. K, The meatus auditorius externus. L, The orbitar plate of the frontal bone, under which is seen the trans-

ANATOMY

Plate III.



verse suture. M, The pars plana of the ethmoid bone. N, The os unguis. O, The right os nasi. P, The superior maxillary bone. Q, Its nasal process. R, The two dentes incisores. S, The dens caninus. T, The two small molares. U, The three large molares. V, The os malæ. W, The lower jaw. X, Its angle. Y, The coronoid process. Z, The condyloid process by which the jaw is articulated with the temporal bone.

Fig. 4. The posterior and Right Side of the Skull.

A, The os frontis. BB, The ossa parietalia. C, The sagittal suture. D, The parietal hole, through which a small vein runs to the superior longitudinal sinus. E, The lambdoid suture. FF, Ossa triquetra. G, The os occipitis. H, The squamous part of the temporal bone. I, The mastoid process. K, The zygoma. L, The os malæ. M, The temporal part of the sphenoid bone. N, The superior maxillary bone and teeth.

Fig. 5. The External Surface of the Os Frontis.

A, The convex part. B, Part of the temporal fossa. C, The external angular process. D, The internal angular process. E, The nasal process. F, The superciliary arch. G, The superciliary hole. H, The orbitar plate.

Fig. 6. The Internal surface of the Os Frontis.

AA, The serrated edge which assists to form the coronal suture. B, The external angular process. C, The internal angular process. D, The nasal process. E, The orbitar plate. F, The cells which correspond with those of the ethmoid bone. G, The passage from the frontal sinus. H, The opening which receives the cribriform plate of the ethmoid bone. I, The cavity which lodges the fore-part of the brain. K, The spine to which the falx is fixed. L, The groove which lodges the superior longitudinal sinus.

Plate III.

Fig. 1. A Back View of the Skeleton.

AA. The ossa parietalia. B, The sagittal suture. C, The lambdoid suture. D, The occipital bone. E, The squamous suture. F, The mastoid process of the temporal bone. G, The os malæ. H, The palate plates of the superior maxillary bones. I, The maxilla inferior. K, The teeth of both jaws. L, The seven cervical vertebræ. M, Their spinous processes. N, Their transverse and oblique processes. O, The last of the twelve dorsal vertebræ. P, The fifth or last lumbar vertebra. Q, The tranverse processes. R, The oblique processes. S, The spinous process. T, The upper part of the os sacrum. U, The posterior holes which transmit small blood vessels and nerves. V, The

under part of the os sacrum which is covered by a membrane. W, The os coccygis. X, The os ilium. Y, Its spine or crest. Z, The ischiatic notch. a, The os ischium. b, Its tuberosity. c, Its spine. d, The os pubis. e, The foramen thyroideum. f, The seventh or last true rib. g, The twelfth or last false rib. h, The clavicle. i, The scapula. K, Its spine. l, Its acromion. m, Its cervix. n, Its superior costa. o, Its posterior costa. p, Its inferior costa. q, The os humeri. r, The radius. s, The ulna. t, Its olecranon. u, All the bones of the carpus, excepting the os pisiforme, which is seen in plate II. fig. 1. v, The five bones of the metacarpus. w, The two bones of the thumb. x, The three bones of each of the fingers. y, The two sesamoid bones of the root of the left thumb. z, The os femoris. 1, The trochanter major. 2, The trochanter minor. 3, The linea aspera. 4, The internal condyle. 5, The external condyle. 6 6, The semilunar cartilages. 7, The tibia. 8, The malleolus internus. 9, The fibula. 10, The malleolus externus. 11, The tarsus. 12, The metatarsus. 13, The toes.

FIG. 2. The External Surface of the Left Os PARIETALE.

A, The convex smooth surface. B, The parietal hole. C, An arch made by the beginning of the temporal muscle.

FIG. 3. The Internal Surface of the same bone.

A, Its superior edge, which, joined with the other, forms the sagittal suture. B, The anterior edge which assists in the formation of the coronal suture. C, The inferior edge for the squamous suture. D, The posterior edge for the lambdoid suture. E, A depression made by the lateral sinus. F, The prints of the arteries of the dura mater.

FIG. 4. The External Surface of the Left Os TEMPORIS.

A, The squamous part. B, The mastoid process. C, The zygomatic process. D, The styloid process. E, The petrosal process. F, The meatus auditorius externus. G, The glenoid cavity for the articulation of the lower jaw. H, The foramen stylo-mastoideum for the portio dura of the seventh pair of nerves. I, Passages for blood vessels into the bone. K, The foramen mastoideum, through which a vein goes to the lateral sinus.

FIG. 5. The Internal Surface of the Left Os TEMPORIS.

A, The squamous part, the upper edge of which assists in forming the squamous suture. B, The mastoid process. C, The styloid process. D, The pars petrosa. E, The entry of The seventh pair, or auditory nerve. F, The fossa, which lodges a part of the lateral sinus. G, The foramen mastoideum.

FIG. 6. The External Surface of the OSSEOUS CIRCLE, which terminates the meatus auditorious externus.

A, The anterior part. B, A small part of the groove in which the membrana tympani is fixed.

N. B. This, with the subsequent bones of the ear, are here delineated as large as the life.

FIG. 7. The Internal Surface of the OSSEOUS CIRCLE.

A, The anterior part. B, The groove in which the membrana tympani is fixed.

FIG. 8. The Situation and Connexion of the Small Bones of the EAR.

A, The malleus. B, The incus. C, The os orbiculare. D, The stapes.

FIG. 9. The MALLEUS, with its Head, Handle, and Small Processes.

FIG. 10. The Incus, with its Body, Superior and Inferior Branches.

FIG. 11. The OS ORBICULARE.

FIG. 12. The STAPES, with its Head, Base, and two Crura.

FIG. 13. An Internal View of the LABYRINTH of the Ear.

A, The hollow part of the cochlea, which forms a share of the meatus auditorius internus. B, The vestibulum. CCC, The semicircular canals.

FIG. 14. An External View of the LABYRINTH.

A, The semicircular canals. B, The fenestra ovalis, which leads into the vestibulum. C, The fenestra rotunda which opens into the cochlea. D, The different turns of the cochlea.

FIG. 15. The Internal Surface of the OS SPHENOIDES.

AA, The temporal processes. BB, The pterygoid processes. CC, The spinous processes. DD, The anterior clinoid processes. E, The posterior clinoid process. F, The anterior process which joins the ethmoid bone. G, The sella turcica for lodging the glandula pituitaria. H, The foramen opticum. K, The foramen lacerum. L, The foramen rotundum. M, The foramen ovale. N, The foramen spinale.

FIG. 16. The External Surface of the OS SPHENOIDES.

AA, The temporal processes. BB, The pterygoid processes. CC, The spinous processes. D, The processus azygos. E, The small triangular processes which grow from the body of the bone. FF, The orifices of the sphenoid sinuses. G, The foramen lacerum. H, The foramen rotundum. I, The foramen ovale. K, The foramen pterygoideum.

FIG. 17. The External View of the Os ETHMOIDES.

A, The nasal lamella. BB, The grooves between the nasal lamella and ossa spongiosa superiora. CC, The ossa spongiosa superiora. DD, The sphenoidal cornua. See Fig. 16. E.

FIG. 18. The Internal View of the Os ETHMOIDES.

A, The crista galli. B, The cribriform plate, with the different passages of the olfactory nerves. CC, Some of the ethmoidal cells. D, The right os planum. EE, The sphenoidal cornua.

FIG. 19. The right SPHENOIDAL CORNU.

FIG. 20. The left SPHENOIDAL CORNU.

FIG. 21. The External Surface of the Os OCCIPITIS.

A, The upper part of the bone, B, The superior arched ridge. C, The inferior arched ridge. Under the arches are prints made by the muscles of the neck. DD, The two condyloid processes which articulate the head with the spine. E, The cuneiform process. F, The foramen magnum through which the spinal marrow passes. GG, The posterior condyloid foramina which transmit veins into the lateral sinuses. HH, The foramina lingualia for the passage of the ninth pair of nerves.

FIG. 22. The Internal Surface of the Os OCCIPITIS.

AA, The two sides which assist to form the lambdoid suture. B, The point of the cuneiform process, where it joins the sphenoid bone. CC, The prints made by the posterior lobes of the brain. DD, Prints made by the lobes of the cerebellum. E, The cruciform ridge for the attachment of the process of the dura mater. F, The course of the superior longitudinal sinuses. GG, The course of the two lateral sinuses. H, The foramen magnum. II, The posterior condyloid foramina.

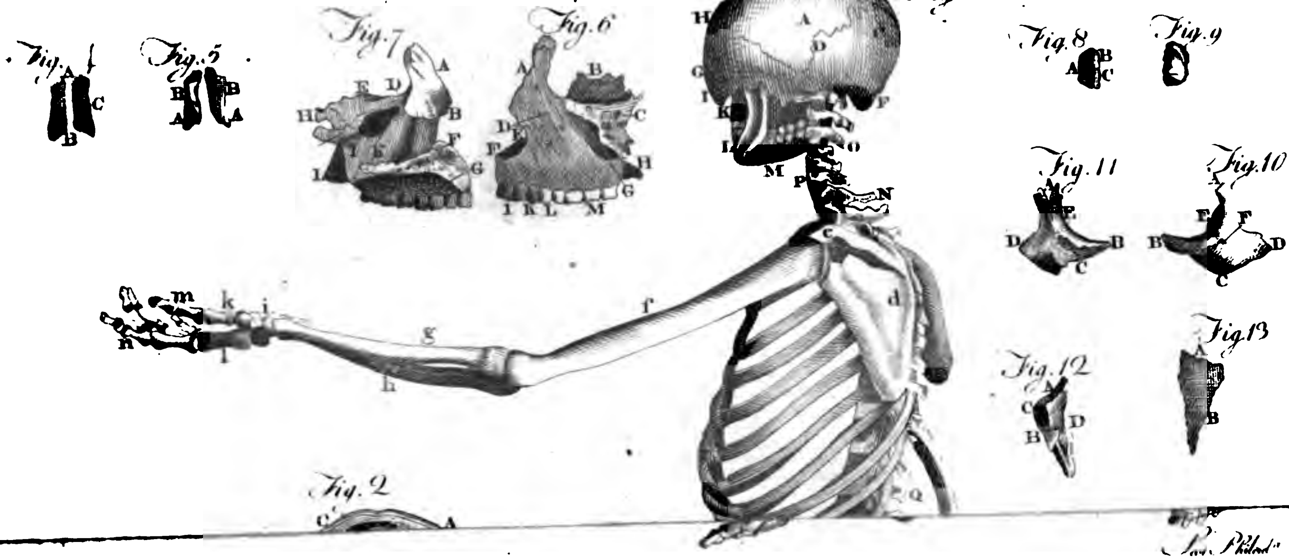
PLATE IV.

FIG. 1. A Sideview of the SKELETON.

AA, The ossa parietalia. B, The sagittal suture. C, The os occipitis. DD, The lambdoid suture. E, The squamous part of the temporal bone. F, The mastoid process. G, The meatus auditorius externus. H, The os frontis. I, The os malæ. K, The os maxillare superius. L, The maxilla inferior. M, The teeth of both jaws. N, The seventh or last cervical vertebra, O, The spinous processes. P, Their transverse and oblique processes. Q, The twelfth or last dorsal vertebra. R, The fifth, or last lumbar vertebra. S, The spinous processes. T, Openings between the vertebræ for the passage of the spinal nerves. U, The under end of the os sacrum. V, The os coc-

ANATOMY

Plate IV



cygis. W, The os ilium. X, The anterior spinous processes. Y, The posterior spinous processes. Z, Ischiatic notch. a, The right os ilium. b, The ossa pubis. c, The tuberosity of the left os ischium. d, The Scapula. e, Its spine. f, The os humeri. g, The radius. h, The ulna. i, The carpus. k, The metacarpal bone of the thumb. l, The metacarpal bones of the fingers. m, The two bones of the thumb. n, The three bones of each of the fingers. o, The os femoris. p, Its head. q, The trochanter major. r, The external condyle. s, The rotula. t, The tibia. u, The fibula. v, The malleolus externus. w, The astragalus. x, The os calcis. y, The os naviculare. z, The three ossa cuneiforma. 1, The os cuboides. 2, The five metatarsal bones. 3, The two bones of the great toe. 4, The three bones of each of the small toes.

FIG. 2. A view of the Internal Surface of the Base of the SKULL.

AAA, The two tables of the skull with the diploe. BB, The orbitar plates of the frontal bone. C, The crista galli, with cribriform plate of the ethmoidal bones on each side of it, through which the first pair of nerves pass. D, The cuneiform process of the occipital bone. E, The cruciform ridge. F, The foramen magnum for the passage of the spinal marrow. G, The zygoma, made by the joining of the zygomatic processes of the os temporum and os malæ. H, The pars squamosa of the os temporis. I, The pars mammillaris. K, The pars petrosa. L, The temporal process of the sphenoid bone. MM, The anterior clinoid processes. N, The posterior clinoid process. O, The sella turcica. P, The foramen opticum for the passage of the optic nerve and ocular artery of the left side. Q, the foramen lacerum, for the third, fourth sixth, and first of the fifth pair of nerves and ocular vein. R, The foramen rotundum, for the second of the fifth pair. S, The foramen ovale, for the third of the fifth pair. T, The forman spinale, for the principal artery of the dura mater. U, the entry of the auditory nerve. V, The passage for the lateral sinus. W, The passage of the eighth pair of nerves. X, The passage of the ninth pair.

FIG. 3. A View of the External Surface of the Base of the SKULL.

A, The two dentes incisores of the right side. B, The dens caninus. C, The two small molares. D, The three large molares. E, The foramen incisivum, which gives passage to small blood vessels and nerves. F, The palate plates of the ossa maxillaria and palati, joined by the longitudinal and transverse palate sutures. G, The foramen palatinum posterius, for

the palatine vessel and nerves. H, The os maxillare superius of the right side. I, The os malæ. K, The zygomatic process of the temporal bone. L, The posterior extremity of the ossa spongiosa. M, The posterior extremity of the vomer which forms the back part of the septum nasi. N, The pterygoid process of the right side of the sphenoid bone. OO, The foramina ovalia. PP, The foramina spinalia. QQ, The passages of the internal carotid arteries. R, A hole between the point of each pars petrosa and cuneiform process, of the occipital bone, which is filled up with a ligamentous substance in the recent subject. S, The passage of the left lateral sinus. T, The posterior condyloid foramen of the left side. U, The foramen mastoideum. V, The foramen magnum. W, The inferior orbitar fissure. X, The glenoid cavity, for the articulation of the lower jaw. Y, The squamous part of the temporal bone. Z, The mastoid process, at the inner side of which is a fossa for the posterior belly of the digastric muscle. a, The styloid process. b, The meatus auditorius externus. c, The left condyle of the occipital bone. d, The perpendicular occipital spine. ee, The inferior horizontal ridge of the occipital bone. ff, The superior horizontal ridge which is opposite to the crucial ridge where the longitudinal sinus divides to form the lateral sinuses. ggg, The lambdoid suture. h, The left squamous suture. i, The parietal bone.

FIG. 4. The anterior surface of the OSSA NASI.

A, The upper part which joins the os frontis. B, The under end, which joins the cartilage of the nose. C, The inner edge, where they join each other.

FIG. 5. The posterior surface of the OSSA NASI.

AA, Their cavity, which forms part of the arch of the nose. BB, Their ridge or spine, which projects a little to be fixed to the forepart of the septum narium.

FIG. 6. The external surface of the OS MAXILLARE SUPERIUS of the left side.

A, The nasal process. B, The orbitar plate. C, The unequal surface which joins the os malæ. D, The external orbitar hole. E, The opening into the nostril. F, The palate-plate. G, The maxillary tuberosity. H, Part of the os palati. I, The two dentes incisores. K, The dens caninus. L, The two small dentes molares. M, The three large dentes molares.

FIG. 7. The internal surface of the OS MAXILLARE SUPERIUS and OS PALATI.

A, The nasal process. BB, Eminences for the connexion of the os spongiosum inferius. D, the under end of the lachrymal groove. E, The antrum maxillare. F, The nasal spine.

between which and B is the cavity of the nostril. G, The palate-plate. H, The orbitar part of the os palati. I, The nasal plate. K, The suture which unites the maxillary and palate bones. The pterygoid process of the palate bone.

FIG. 8. The external surface of the right Os UNGUIS.

A, The orbitar part. B, The lachrymal part. C, The ridge between them.

FIG. 9. The internal surface of the right Os UNGUIS.

This side of the bone has a furrow opposite to the external ridge; all behind this is irregular, where it covers part of the ethmoidal cells.

FIG. 10. The external surface of the left Os MALÆ.

A, the superior orbitar process. B, The inferior orbitar process. C, The malar process. D, The zygomatic process. E, The orbitar plate. F, A passage for small vessels into or out of the orbit.

FIG. 11. The internal surface of the left Os MALÆ.

A, The superior orbitar process. B, The inferior orbitar process. C, The malar process. D, The zygomatic process. E, the internal orbitar plate or process.

FIG. 12. The external surface of the right Os SPONGIOSUM INFERIUS.

A, The anterior part. B, The hook-like process for covering part of the antrum maxillare. C, A small process which covers part of the under end of the lachrymal groove. D, The inferior edge turned a little outwards.

FIG. 13. The internal surface of the Os SPONGIOSUM INFERIUS.

A, The anterior extremity. B, The upper edge which joins the superior maxillary and palate bones.

FIG. 14. The posterior and external surface of the right Os PALATI.

A, the orbitar process. B, The nasal lamella. C, The pterygoid process. D, The palate process.

FIG. 15. The interior and external surface of the right Os PALATI.

A, The orbitar process. B, An opening through which the lateral nasal vessels and nerves pass. C, The nasal lamella. D, The pterygoid process. E, The posterior edge of the palate process for the connexion of the velum palati. F, The inner edge by which the two ossa palati are connected.

FIG. 16. The right side of the VOMER.

A, The upper edge which joins the nasal lamella of the

ethmoid bone and the middle cartilage of the nose. B, The inferior edge, which is connected to the superior maxillary and palate bones. C, The superior and posterior part which receives the processes azygos of the sphenoid bone.

FIG. 17. The MAXILLA INFERIOR.

A, The chin. B, The base and left side. C, The angle. D, The coronoid process. E, The condyloid process. F, The beginning of the inferior maxillary canal of the right side, for the entry of the nerves and blood vessels. G, The termination of the left canal. H, The two dentes incisores. I, The dens caninus. K, The two small molares. L, The three large molares.

FIG. 18. The different classes of the TEETH.

1, 2, A fore and back view of the two anterior dentes incisores of the lower jaw. 3, 4, Similar teeth of the upper jaw. 5, 6, A fore and back view of the dentes canini. 7, 8, The anterior dentes molares. 9, 10, 11, The posterior dentes molares. 12, 13, 14, 15, 16, Unusual appearances in the shape and size of the teeth.

FIG. 19. The external surface of the OS HYOIDES.

A, The body. BB, The cornua. CC. The appendices.

PLATE V.

FIG. 1. A posterior view of the STERNUM and CLAVICLES, with the ligament connecting the clavicles to each other.

a, The posteror surface of the sternum. bb, The broken end of the clavicle. cccc, The tubercles near the extremity of each clavicle. d. The ligament connecting the clavicles.

FIG. 2. A Fore-view of the Left Scapula, and a half of the Clavicle, with their Ligaments.

a, The spine of the scapula. b, The acromion. c, The inferior angle. d, Inferior costa. e, Cervix. f, Glenoid cavity, covered with cartilage for the arm-bone. gg, The capsular ligament of the joint. h, Coracoid process. i, The broken end of the clavicle. k, Its extremity joined to the acromion. l, A ligament coming out single from the acromion to the coracoid process. m, A ligament coming out single from the acromion, and dividing into two, which are fixed to the coracoid process.

FIG. 3. The Joint of the Elbow of the Left Arm, with the Ligaments.

a, The os humeri. b, Its internal condyle. cc, The two prominent parts of its trochlea appearing through the capsular ligament. d, The ulna. e, The radius. f, The part of the ligament including the head of the radius.

ANATOMY

Plate V

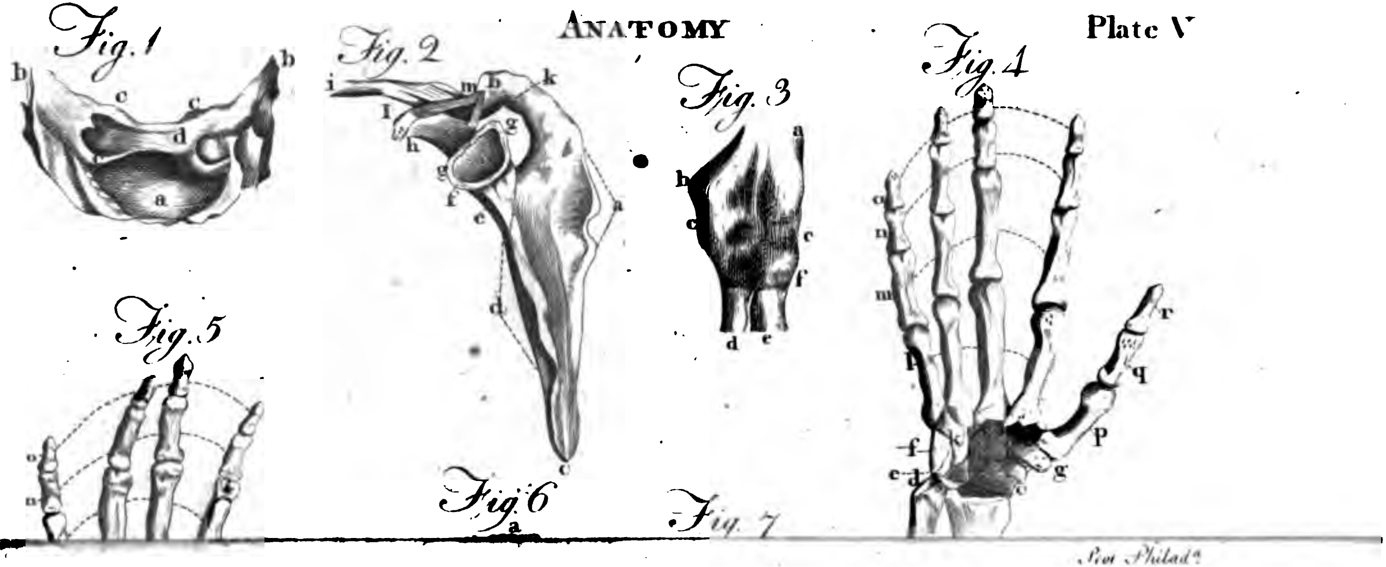


FIG. 4. The bones of the Right Hand, with the Palm in view.

a, The radius. b, The ulna. c, The scaphoid bone of the carpus. d, The os lunare. e, The os cuneiforme. f, The os pisiforme. g, Trapezium. h, Trapezoides. i, Magnum. k, Unciforme. l, The four metacarpal bones of the fingers. m, The first phalanx. n, The second phalanx. o, The third phalanx. p, The metacarpal bone of the thumb. q, The first joint. r, The second joint.

FIG. 5. The posterior view of the Bones of the Left Hand.

The explication of Fig. 4, serves for this figure; the same letters pointing out the same bones, though in a different view.

FIG. 6. The Upper Extremity of the Tibia, with the Semilunar Cartilages of the Joint of the Knee, and some Ligaments.

a, The strong ligament which connects the rotula to the tubercle of the tibia. bb, The parts of the extremity of the tibia covered with cartilage, which appear within the semilunar cartilages. cc, The semilunar cartilages. d, The two parts of what is called the cross ligament.

FIG. 7. The posterior view of the Joint of the Right Knee.

a, The os femoris cut. b, Its internal condyle. c, Its external condyle. d, The back part of the tibia. e, The superior extremity of the fibula. f, The edge of the internal semilunar cartilage. g, An oblique ligament. h, A large perpendicular ligament. i, A ligament connecting the femur and fibula.

FIG. 8. The anterior view of the Joint of the Right Knee.

b, The internal condyle. c, Its external condyle. d, The part of the os femoris, which the patella moves. e, A perpendicular ligament. ff, The two parts of the crucial ligaments. gg, The edges of the two moveable semilunar cartilages. h, The tibia. i, The strong ligament of the patella. k, The back part of it where the fat has been dissected away. l, The external depression. m, The internal one. n, The cut tibia.

FIG. 9. A view of the inferior part of the bones of the Right Foot.

a, The great knob of the os calcis. b, A prominence on its outside. c, The hollow for the tendons, nerves and blood vessels. d, The anterior extremity of the os calcis. e, Part of the astragalus. f, Its head covered with cartilage. g, The internal prominence of the os naviculare. h, The os cuboides. i, The os cuneiform internum. k, Medium. l, Externum. m, The metatarsal bones of the four lesser toes. n, The first. o, The second. p, The third phalanx of the four lesser toes. q,

The metatarsal bones of the great toe. r, Its first—s, Its second joint.

FIG. 10. The inferior surface of the two large SESAMOID BONES, at the first Joint of the Great Toe.

FIG. 11. The superior view of the Bones of the Right Foot.

a, b, as in Fig. 9. c, The superior head of the astragalus. d, &c. as in Fig. 9.

FIG. 12. The view of the SOLE of the FOOT, with its Ligaments.

a, The great knob of the os calcis. b, The hollow for the tendons, nerves, and blood vessels. c, The sheaths of the flexores pollicis and digitorum longi opened. d, The strong cartilaginous ligament supporting the head of the astragalus. e, h, Two ligaments which unite into one, and are fixed to the metatarsal bone of the great toe. f, A ligament from the knob of the os calcis to the metatarsal bone of the little toe. g, A strong triangular ligament, which supports the bones of the tarsus. i, The ligaments of the joints of the five metatarsal bones.

FIG. 13. a, The head of the thigh bone of a child. b, The ligamentum rotundum connecting it to the acetabulum. c, The capsular ligament of the joint with its arteries injected. d, The numerous vessels of the mucilaginous gland injected.

FIG. 14. The back-view of the Cartilages of the LARYNX, with the Os Hyoides.

a, The posterior part of the base of the os hyoides. bb, Its cornua. c, The appendix of the right side. d, A ligament sent out from the appendix of the left side, to the styloid process of the temporal bone. e, The union of the base with the left cornu. ff, The posterior sides of (g) the thyroid cartilage. hh, Its superior cornua. ii, Its inferior cornua. k, the cricoid cartilage. ll, The arytenoid cartilages. m, The entry into the lungs, named *glottis.* n, The epiglottis. oo, The superior cartilages of the trachea. p, Its ligamentous back part.

FIG. 15. The superior concave surface of the SESAMOID BONES at the first joint of the Great Toe, with their Ligaments.

a, Three sesamoid bones. b, The ligamentous substance in which they are formed.

ANATOMY. Plate VI

Fig. 2.

Fig. 1.

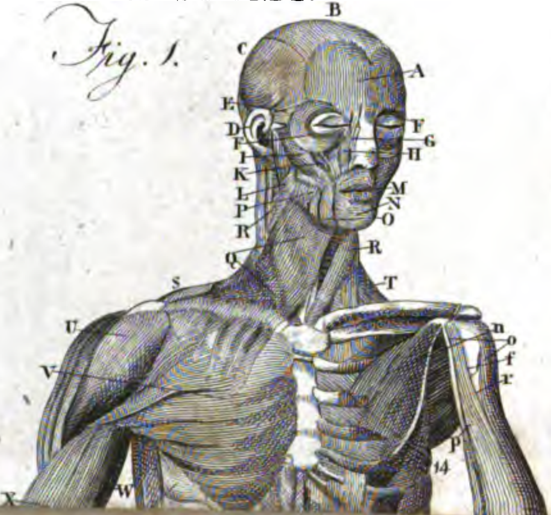


Fig. 3.

EXPLANATION OF PLATES VI. AND VII.

Plate VI.

Fig. 1. The Muscles immediately under the common teguments on the anterior part of the body are represented on the right side; and on the left side the Muscles are seen which come in view when the exterior ones are taken away.

A, The frontal muscle. B, The tendinous aponeurosis which joins it to the occipital; hence both are named *occipito-frontalis*. C, Attollens aurem. D, The ear. E, Anterior auris. FF, Orbicularis palpebrarum. G, Levator labii superioris alæque nasi. H, Levator anguli oris. I, Zygomaticus minor. K, Zygomaticus major. L, Masseter. M, Orbicularis oris. N, Depressor labii inferioris. O, Depressor anguli oris. P, Buccinator. QQ, Platysma myoides. RR, Sterno-cleido-mastoideus. S, Part of the trapezius. T, Part of the scaleni.

Superior Extremity.—U, Deltoides. V, Pectoralis major. W, Part of the latissimus dorsi. XX, Biceps flexor cubiti. YY, Part of the triceps extensor. ZZ, The beginning of the tendinous aponeurosis, (from the biceps,) which is spread over the muscles of the forearm. aa, Its strong tendon inserted into the tubercle of the radius. bb, Part of the brachialis internus. c, Pronator radii teres. d, Flexor carpi radialis. e, Part of the flexor carpi ulnaris. f, Palmaris longus. g, Aponeurosis palmaris. 3, palmaris brevis. 1, Ligamentum carpi annulare. 2 2, Abductor minimi digiti. h, Supinator radii longus. i, The tendons of the thumb. k, Abductor pollicis. l, Flexor pollicis longus. mm, The tendons of the flexor sublimis perforatus, profundus perforans, and lumbricales. The sheaths are entire in the right hand,—in the left cut open to show the tendons of the flexor profundus perforating the sublimis.

Muscles—not referred to—in the left superior extremity. n, Pectoralis minor, seu serratus anticus minor. o. The two heads of (xx) the biceps. p, Coraco-brachialis. qq, The long head of the triceps extensor cubiti. rr, Teres major. ss, Subscapularis. tt, Extensores radialis. u, Supinator brevis. v, The cut extremity of the pronator teres. w, Flexor sublimis perforatus. x, Part of the flexor profundus. y, Flexor pollicis longus. z, Part of the flexor pollicis brevis. 4, Abductor minimi digiti. 5, The four lumbricales.

Trunk.—6, Serrated extremities of the serratus anticus ma-

jor. 7 7, Obliquus externus abdominis. 8 8, The linea alba. 9, The umbilicus. 10, Pyramidalis. 11 11, The spermatic cord. On the left side it is covered by the cremaster. 12 12, Rectus abdominis. 13, Obliquus internus. 14 14, &c. Intercostal muscles.

Inferior Extremities.—*a a*, The gracilis. *b b*, Parts of the triceps. *c c*, Pectinalis. *d d*, Psoas magnus. *e e*, Iliacus internus. *f*, Part of the glutæus medius. *g*, Part of the glutæus minimus. *h*, Cut extremity of the rectus femoris. *i i*, Vastus externus. *k*, Tendon of the rectus femoris. *l l*, Vastus internus. *Sartorius muscle. **Fleshy origin of the tensor vaginæ femoris or membranosus. Its tendinous aponeurosis covers (*i*) the vastus externus on the right side. *m m*, Patella. *n n*, Ligament or tendon from it to the tibia. *o*, Rectus femoris. *p*, Cruræus. *q q*, The tibia. *r r*, Part of the Gemellus, or gastrocnemius externus. *s s s*, Part of the soleus or gastrocnemius internus. *t*, Tibialis anticus. *u*, Tibialis posticus. *v v*, Peronæi muscles. *w w*, Extensor longus digitorum pedis. *x x*, Extensor longus pollicis pedis. *y*, Abductor pollicis pedis.

Fig. 2. The Muscles, Glands, &c. of the Left Side of the face and neck, after the common Teguments and Platysma myoides have been taken off.

a, The frontal muscle. b, Temporalis and temporal artery, c, Orbicularis palpebrarum. d, Levator labii superioris alæque nasi. e, Levator anguli oris. f, Zygomaticus. g, Depressor labii inferioris. h, Depressor anguli oris. i, Buccinator. k, Masseter. l l, Parotid gland. m, Its duct. n, Sterno-cleido-mastoideus. o, Part of the trapezius. p, Sterno-hyoideus. q, Sterno-thyroideus. r, Omo-hyoideus. f, Levator scapulæ. tt, Scaleni. u, Part of the splenius.

Fig. 3. The Muscles of the Face and Neck in view after the exterior ones are taken away.

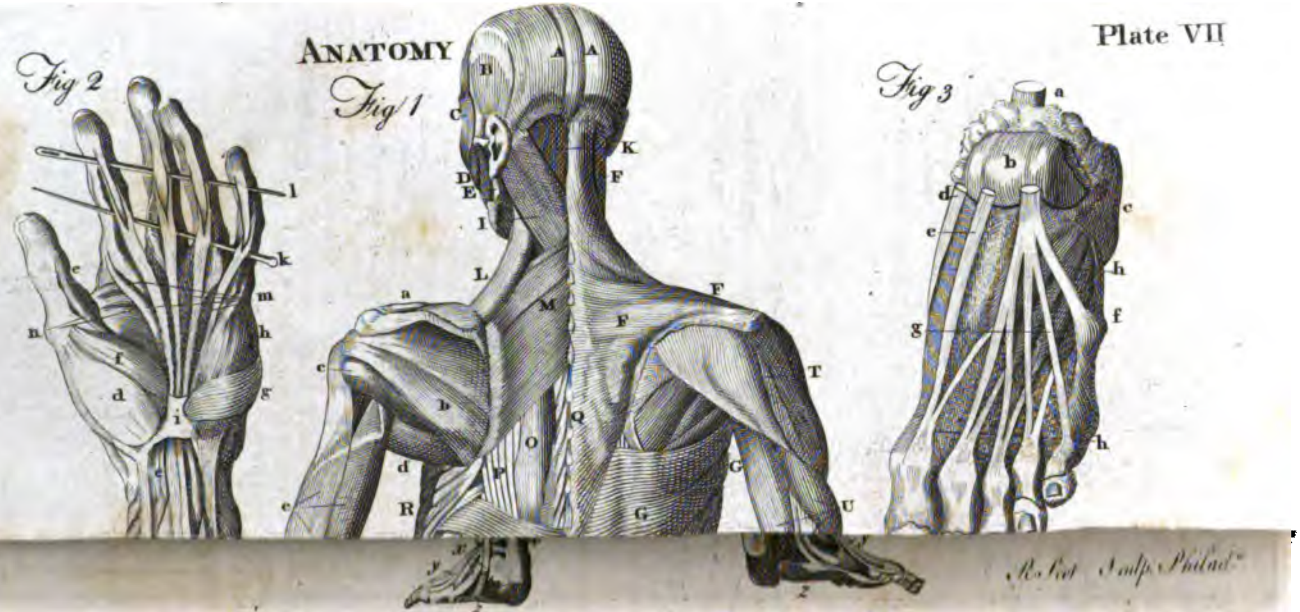
aa, Corrugator supercilii. b, Temporalis. c, Tendon of the lavator palpebræ superioris. d, Tendon of the orbicularis palpebrarum. e, Masseter. f, Buccinator. g, Levator anguli oris. h, Depressor labii superioris alæque nasi. i, Orbicularis oris, k, Depressor anguli oris. l, Muscles of the os hyoides. m, Sterno-cleido-mastoideus.

Fig. 4. Some of the Muscles of the Os Hyoides and Submaxillary Gland.

a, Part of the masseter muscle. b, Posterior head of the digastric. c, Its anterior head. d d, Sterno-hyoideus. e, Omo-hyoideus. f, Stylo-hyoideus. g, Submaxillary gland in situ.

ANATOMY

Plate VII



R. Scot Sculp. Philad.

FIG. 5, The Submaxillary Gland and Duct.

a, Musculus mylo-hyoideus. b, Hyo-glossus. c, Submaxillary gland removed from its place. d, Its duct.

PLATE VII.

FIG. 1. The Muscles immediately under the common teguments on the posterior part of the body, are represented on the right side; and on the left side the Muscles are seen which come in view when the exterior ones are taken away.

HEAD.—AA, Occipito-frontalis. B, Attollens aurem. C, Part of the orbicularis palpebrarum. D, Masseter. E, Pterygoideus internus.

TRUNK.—Right side. FFF, Trapezius seu cucullaris. GGGG, Latissimus dorsi. H, Part of the obliquus externus abdominis.

TRUNK.—Left side. I, Splenius. K, part of the complexus. L, Levator scapulæ. M, Rhomboides. NN, Serratus posticus inferior. O, Part of the longissimus dorsi. P, Part of the sacro lumbalis. Q, Part of the semi-spinalis dorsi. R, Part of the serratus anticus major. S, Part of the obliquus internus abdominis.

SUPERIOR EXTREMITY.—Right side. T, Deltoides. U, Triceps extensor cubiti. V, Supinator longus. WW, Extensores carpi radialis longior and brevior. XX, Extensor carpi ulnaris. YY, Extensor digitorum communis. Z, Abductor indicis. 1, 2, 3, Extensores pollicis.

SUPERIOR EXTREMITY.—Left side. a, Supra Spinatus. b, Infraspinatus. c, Teres minor. d, Teres major. e, Triceps extensor cubiti. ff, Extensores carpi radialis. g, Supinator brevis. h, Indicater. 1, 2, 3, Extensores pollicis. i, Abductor minimi digiti. k, Interossei.

INFERIOR EXTREMITY.—Right side. l, Glutæus maximus. m, Part of the Glutæus medius. n, Tensor vaginæ femoris. o, Gracilis. pp, Adductor femoris magnus. q, Part of the vastus internus. r, Semimembranosus. s, Semitendinosus. t, Long head of the biceps flexor cruris. uu, Gastrocnemius externus seu gemellus. v, Tendo Achillis. w, Soleus seu gastrocnemius internus. xx, Peronæus longus and brevis. y, Tendons of the flexor longus digitorum pedis; and under them *flexor brevis digitorum pedis. z, Abductor minimi digiti pedis.

INFERIOR EXTREMITY.—Left side. m, n, o, pp, q, r, s, t, v, ww, xx, y, z, Point the same parts as in the right side. a, Pyriformus. bb, Gemini. cc, Obturator internus. d, Quadratus femoris. e, Coccygæus. f, The short head of the biceps flexor cruris. gg, Plantaris. h, Popliteus. i, Flexor longus pollicis pedis.

FIG. 2. The Palm of the Left Hand after the common Teguments are removed, to show the Muscles of the Fingers.

a, Tendon of the flexor carpi radialis. b, Tendon of the flexor carpi ulnaris. c, Tendons of the flexor sublimis perforatus, profundus perforans and lumbricales. d, Abductor pollicis. ee, Flexor pollicis longus. f, Flexor pollicis brevis. g, Palmaris brevis. h, Abductor minimi digiti. i, Ligamentum carpi annulare. k, A probe put under the tendons of the flexor digitorum sublimis; which are performed by l, the flexor digitorum profundus. mmmm, Lumbricales. n, Abductor pollicis.

FIG. 3. A fore-view of the foot and tendons of the flexores Digitorum.

a, Cut extremity of the Tendo Achillis. b, Upper part of the astragalus. c, Os calcis. d, Tendon of the tibialis anticus. e, Tendon of the extensor pollicis longus. f, Tendon of the peroneus brevis. g, Tendons of the flexor digitorum longus, with the nonus Vesalii. hh, The whole of the flexor digitorum brevis.

FIG. 4. Muscles of the Anus.

aa, An outline of the buttocks, and upper part of the thighs. b, The testes contained in the scrotum. cc, Sphincter ani. d, Anus. e, Levator ani. ff, Erector penis. gg, Accelerator urinæ. h, Corpus cavernosum urethræ.

FIG. 3. Muscles of the Penis.

aa, b, d, ee, ff, h, point the same as in fig. 4. c, Sphincter ani. gg, Transversalis penis.

EXPLANATION OF PLATES VIII. IX. AND X.

PLATE VIII.

FIG. 1. Shows the Contents of the Thorax and Abdomen in situ.

1, Top of the trachea, or windpipe. 2 2, The internal jugular veins. 3 3, The subclavian veins. 4, The vena cava descendens. 5, The right auricle of the heart. 6, The right ventricle. 7, Part of the left ventricle. 8, The aorta descendens. 9, The pulmonary artery. 10, The right lung, part of which is cut off to show the great blood vessels. 11, The left lung entire. 12 12, The anterior edge of the diaphragm. 13 13, The two great lobes of the liver. 14, The ligamentum rotundum. 15, The gall bladder. 16, The stomach. 17 17, The jejunum and ilium. 18, The spleen.

ANATOMY

Plate VIII.

Fig. 1

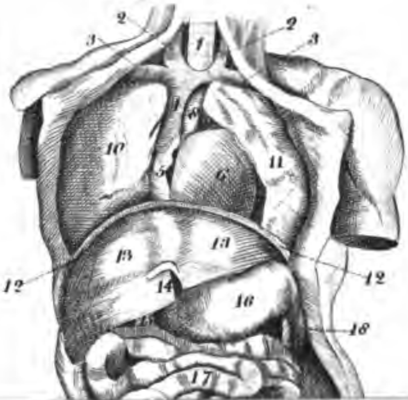


Fig. 2

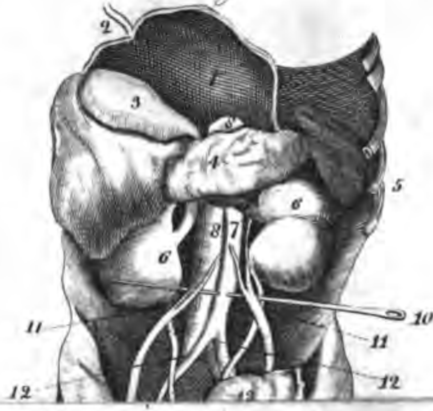


FIG. 2. Shows the organs subservient to the Chylopoietic Viscera,—with those of Urine and Generation.

11, The under side of the two great lobes of the liver. a, Lobulus spigelii. 2, The ligamentum rotundum. 3, The gall-bladder. 4, The pancreas. 5, The spleen. 6 6, The kidneys. 7, The aorta descendens. 8, Vena cava ascendens. 9 9, The renal veins covering the arteries. 10, A probe under the spermatic vessels and a bit of the inferior mesenteric artery, and over the ureters. 11 11, The ureters. 12 12, The iliac arteries and veins. 13, The intestinum rectum. 14, The bladder of urine.

FIG. 3. Shows the Chylopoietic Viscera, and Organs subservient to them, taken out of the body entire.

AA, The under side of the two great lobes of the liver. B, Ligamentum rotundum. C, The gall-bladder. D, Ductus cysticus. E, Ductus hepaticus. F, Ductus communis choledochus. G, Vena portarum. H, Arteria hepatica. I, The stomach. KK, Venæ and arteriæ gastro-epiploicæ, dextræ and sinistræ. LL, Venæ and arteriæ coronariæ ventriculi. M, The spleen. NN, Mesocolon, with its vessels. OOO, Intestinum colon. P, One of the ligaments of the colon, which is a bundle of longitudinal muscular fibres. QQQQ, Jejunum and ilium. RR, Sigmoid flexure of the colon with the ligament continued, and over. S, The intestinum rectum. TT, Levatores ani. U, Sphincter ani. V, The place to which the prostate gland is connected. W, The anus.

FIG. 4. Shows the Heart of a Fœtus at the full time, with the Right Auricle cut open, to show the Foramen Ovale, or passage between both Auricles.

a, The right ventricle. b, The left ventricle. cc, The outer side of the right auricle stretched out. dd, The posterior side, which forms the anterior side of the septum. e, The foramen ovale, with the membrane or valve which covers the left side. f, Vena cava inferior passing through. g, A portion of the diaphragm.

FIG. 5. Shows the Heart and Large Vessels of a Fœtus at the full time.

a, The left ventricle. b, The right ventricle. c, A part of the right auricle. d, Left auricle. ee, The right branch of the pulmonary artery. f, Arteria pulmonalis. gg, The left branch of the pulmonary artery, with a number of its largest branches dissected from the lungs. h, the canalis arteriosus. i, The arch of the aorta. kk, The aorta descendens. l, The left sub-

clavian artery. m, The left carotid artery. n, The right carotid artery. o, The right subclavian artery. p, The origin of the right carotid and right subclavian arteries in one common trunk. q, the vena cava superior or descendens. r, The right common subclavian vein. s, The left common subclavian vein.

N. B. All the parts described in this figure are to be found in the adult, except the canalis arteriosus.

Plate IX.

Fig. 1. Exhibits the more superficial Lymphatic Vessels of the Lower Extremity.

A, The spine of the os ilium. B, The os pubis. c, The iliac artery. D, The Knee. E, E, F, Branches of the crural artery. G, The musculus gastrocnemius. H, The tibia. I, The tendon of the musculus tibialis anticus. On the outlines, a, A lymphatic vessel belonging to the top of the foot. b, Its first division into branches. c, c, c, Other divisions of the same lymphatic vessel. d, A small lymphatic gland. e, The lymphatic vessels which lie between the skin and the muscles of the thigh. ff, Two lymphatic glands at the upper part of the thigh, below the groin. gg, Other glands. h, A lymphatic vessel which passes by the side of those glands without communicating with them, and bending towards the inside of the groin at (i,) opens into the lymphatic gland (k.) ll, Lymphatic glands in the groin, which are common to the lymphatic vessels of the genitals and those of the lower extremity. m, n, A plexus of lymphatic vessels passing on the inside of the iliac artery.

Fig. 2. Exhibits a back-view of the Lower Extremity, dissected so as to show the deeper-seated Lymphatic Vessels which accompany the Arteries.

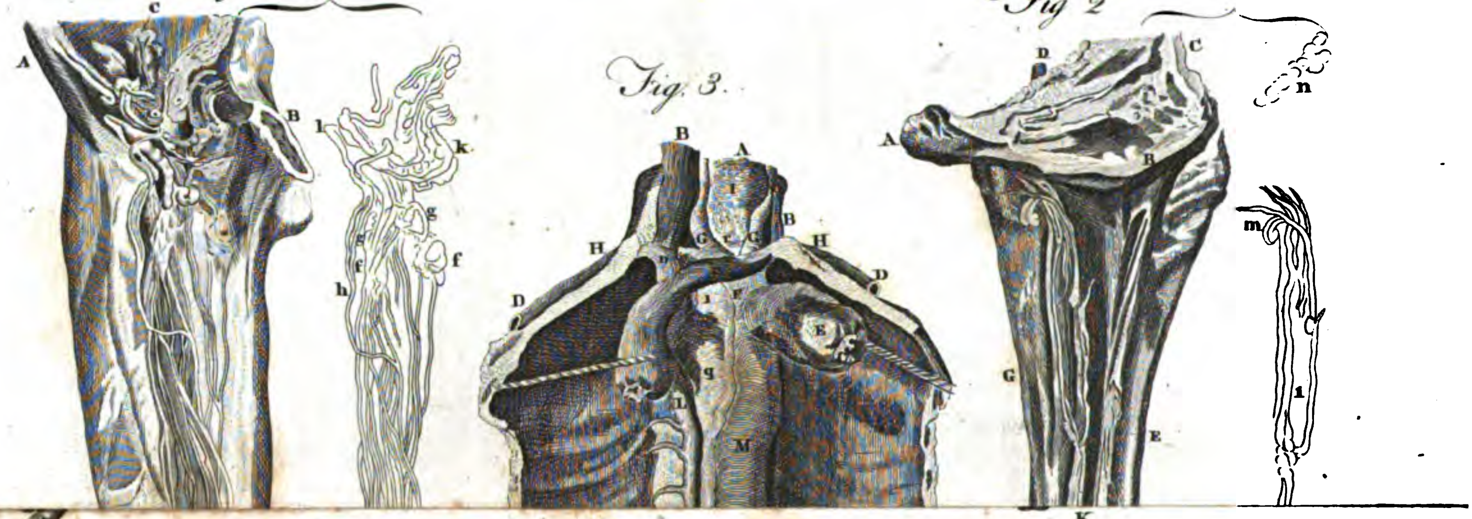
A, The os pubis. B, The tuberosity of the ischium. C, That part of the os ilium which was articulated with the os sacrum. D, The extremity of the iliac artery appearing above the groin. E, The knee. FF, The two cut surfaces of the triceps muscle, which was divided to show the lymphatic vessels that pass through its perforation along with the crural artery. G, The edge of the musculus gracilis. H, The gastrocnemius and soleus much shrunk by being dried, and by the soleus being separated from the tibia to expose the vessels. I, The heel. K, The sole of the foot. L, The superficial lymphatic vessels passing over the knee, to get to the thigh. On the outlines: M, the posterior tibial artery. a, A lymphatic vessel accompanying the posterior tibial artery. b, The same vessel crossing the artery. c, A small lymphatic gland, through which this deep-

ANATOMY Plate IX

Fig 1

Fig. 3.

Fig 2



seated lymphatic vessel passes. d, The lymphatic vessel passing under a small part of the soleus, which is left attached to the bone, the rest being removed. e, The lymphatic vessel crossing the popliteal artery. f, g, h, Lymphatic glands in the ham, through which the lymphatic vessel passes. i, The lymphatic vessel passing with the crural artery, through the perforation of the triceps muscle. k, The lymphatic vessel, after it has passed the perforation of the triceps, dividing into branches, which embrace the artery (l.) m, A lymphatic gland belonging to the deep-seated lymphatic vessel. At this place those vessels pass to the fore part of the groin, where they communicate with the superficial lymphatic vessel. n, A part of the superficial lymphatic vessel appearing on the brim of the pelvis.

FIG. 3. Exhibits the Trunk of the Human Subject prepared to show the Lymphatic Vessels and the Ductus Thoracicus.

A, The neck. BB, The two jugular veins. C, The vena cava superior. DDDD, The subclavian veins. E, The beginning of the aorta, pulled to the left side by means of a ligature, in order to show the thoracic duct behind it. F, The branches arising from the curvature of the aorta. GG, The two carotid arteries. HH, The first ribs. II, The trachea. KK, The spine. LL, The vena azygos. MM, The descending aorta. N, The cœliac artery, dividing into three branches. O, The superior mesenteric artery. P, The right crus diaphragmatis. QQ, The two kidneys. R, The right emulgent artery. SS, The external iliac arteries. g, d, The psoas muscles. T, The internal iliac artery. U, The cavity of the pelvis. XX, The spine of the os ilium. YY, The groins. a, A lymphatic gland in the groin, into which lymphatic vessels from the lower extremity are seen to enter. bb, The lymphatic vessels of the lower extremities passing under Poupart's ligament. cc, A plexus of the lymphatic vessels lying on each side of the pelvis. d, The psoas muscle with lymphatic vessels lying upon its inside. e, A plexus of lymphatics, which, having passed over the brim of the pelvis at (c,) having entered the cavity of the pelvis, and received the lymphatic vessels belonging to the viscera contained in that cavity, next ascends and passes behind the iliac artery to (g.) f, Some lymphatic vessels of the left side passing over the upper part of the os sacrum, to meet those of the right side. g, The right psoas, with a large plexus of lymphatics lying on its inside. hh, The plexus lying on each side of the spine. i i i, Spaces occupied by the lymphatic glands. k, The trunk of the lacteals lying on the under side of the superior mesenteric artery. l, The same dividing into two branches, one of which passes on each

side of the aorta: that of the right side being seen to enter the thoracic duct at (*m.*) *m*, The thoracic duct beginning from the large lymphatics. *n*, The duct passing under the lower part of the crus diaphragmatis, and under the right emulgent artery. *o*, The thoraric duct penetrating the thorax. *p*, Some lymphatic vessels joining that duct in the thorax. *q*, The thoracic duct passing under the curvature of the aorta to get to the left subclavian vein—the aorta being drawn aside to show the duct. *r*, A plexus of lymphatic vessels passing upon the trachea from the thyroid gland to the thoracic duct.

Plate X.

Fig. 1. Represents the under and posterior side of the Bladder of Urine, &c.

a, The bladder. bb, The insertion of the ureters. cc, The vasa deferentia, which convey the semen from the testicles to dd, the vesciculæ seminales,—and pass through e, the prostate gland, to discharge themselves into f, the beginning of the urethra.

Fig. 2. A transverse Section of the Penis.

gg, Corpora cavernosa penis. h, Corpus cavernosum urethræ. i, Urethra. k, Septum penis. ll, The septum between the corpus cavernosum urethræ and that of the penis.

Fig. 3. A longitudinal Section of the Penis.

mm, The corpora cavernosa penis, divided by o, the septum penis. n, The corpus cavernosum glandis, which is the continuation of that of the urethra.

Fig. 4. Represents the Female Organs of Generation.

a, That side of the uterus, which is next to the os sacrum. 1, Its fundus. 2, Its cervix. bb, The Fallopian or uterine tubes, which open into the cavity of the uterus;—but the other end is open within the pelvis, and surrounded by cc, the fimbriæ. dd, The ovaria. e, The os internum uteri, or mouth of the womb. ff, The ligamentum rotundum, which passes without the belly, and is fixed to the labia pudendi. gg, The cut edges of the ligamenta lata, which connect the uterus to the pelvis. h, The inside of the vagina. i, The orifice of the urethra. k, The clitoris surrounded by (l,) The præptium. mm, The labia pudendi. nn, The nymphæ.

Fig. 5. Shows the Spermatic Ducts of the Testicle filled with Mercury.

A, The vas deferens. B, Its beginning, which forms the

ANATOMY

Plate X

Fig. 1

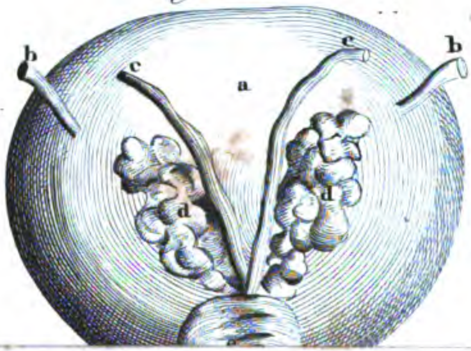


Fig. 4

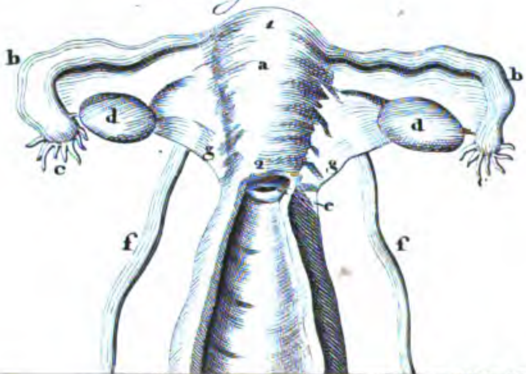


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Plate XI

posterior part of the epididymis. C, The middle of the epididymis, composed of serpentine ducts. D, The head or anterior part of the epididymis unravelled. e e e e, The whole ducts which compose the head of the epididymis unravelled. f f, The vasa deferentia. gg, Rete testis. hh, Some rectilinear ducts which send off the vasa deferentia. ii, The substance of the testicle.

FIG. 6. The Right Testicle entire, and the Epididymis filled with Mercury.

A, The beginning of the vas deferens. B, The vas deferens ascending towards the abdomen. C, The posterior part of the epididymis, named *globus minor*. D, The spermatic vessels enclosed in cellular substance. E, The body of the epididymis. F, Its head, named *globus major*. G, Its beginning from the testicle. H, The body of the testicle, enclosed in the tunica albuginea.

EXPLANATION OF PLATE XI.

This plate represents the Heart in situ, all the large Arteries and Veins, with some of the Muscles, &c.

MUSCLES, &c.—SUPERIOR EXTREMITY.—a, Masseter. b, Complexus. c, Digastricus. d, Os hyoides. e, Thyroid gland. f, Levator scapulæ. g, Cucullaris. hh, The clavicles, cut. i, The deltoid muscle. k, Biceps flexor cubiti, cut. l, Coracobrachialis. m, Triceps extensor cubiti. n, The heads of the pronator teres, flexor carpi radiales, and flexor digitorum sublimis, cut. o, The flexor carpi-ulnaris, cut at its extremity. p, Flexor digitorum profundus. q, Supinator radii longus, cut at its extremity. r, Ligamentum carpi transversale. s, Extensores carpi radiales. t, Latissimus dorsi. u, Anterior edge of the serratus anticus major. vv, The inferior part of the diaphragm. ww, Its anterior edge cut. xx, The kidneys. y, Transversus abdominus. z, Os ilium,

INFERIOR EXTREMITY.—*a*, Psoas magnus. *b*, Iliacus internus. *c*, The fleshy origin of the tensor vagina femoris. *dd*, The ossa pubis cut from each other. *e*, Musculus pectineus cut from its origin. *f*, Short head of the triceps abductor femoris cut. *g*, The great head of the triceps. *h*, The long head cut. *i*, Vastus internus. *k*, Vastus externus. *l*, Crureus. *m*, Gemellus. *n*, Soleus. *o*, Tibia, *p*, Peroneus longus. *q*, Peroneus brevis. *r*, Fibula.

HEART AND BLOOD-VESSELS.—A, The heart, with the coronary artery and veins. B, The right auricle of the heart. C, The aorta ascendens, D, The left subclavian artery. E, The

left carotid artery. F, The common trunk which sends off the right subclavian and right carotid arteries. G, The carotis externa. H, Arteria facialis, which sends off the coronary arteries of the lips. I, Arteria temporalis profunda. K, Aorta descendens. LL, The iliac arteries, which sends off MM, The femoral or crural arteries. N. B. The other arteries in this figure have the same distribution as the veins of the same name:—And generally, in the anatomical plates, the description to be found on the one side, points out the same parts in the other. 1, The frontal vein. 2, The facial vein. 3, Vena temporalis profunda. 4, Vena occipitalis. 5, Vena jugularis externa. 6, Vena jugularis interna, covering the arteria carotis communis. 7, The vascular arch on the palm of the hand, which is formed by, 8, The radial artery and vein, and 9, The ulnar artery and vein. 10 10, Cephalic vein. 11, Basilic vein, that on the right side cut. 12, Median vein. 13, The humeral vein, which, with the median, covers the humeral artery. 14 14, The external thoracic or mammary arteries and veins. 15, The axillary vein, covering the artery. 16 16, The subclavian veins, which, with (6 6,) the jugulars, form, 17, The vena cava superior. 18, The cutaneous arch of veins on the fore part of the foot. 19, The vena tibialis antica, covering the artery. 20, The vena profunda femoris, covering the artery. 21, The upper part of the vena saphena major. 22, The femoral vein. 23 23, The iliac veins. 24 24, Vena cava inferior. 25 25, The renal veins covering the arteries. 26 26, The diaphragmatic veins.

EXPLANATION OF PLATE XII.

Fig. 1. Represents the Inferior part of the Brain;—the Anterior part of the whole Spine, including the Medulla Spinalis;—with the origin and large portions of all the Nerves.

AA, The anterior lobes of the cerebrum. BB, The lateral lobes of the cerebrum. CC, The two lobes of the cerebellum. D, Tuber annulare. E, The passage from the third ventricle to the infundibulum. F, The medulla oblongata, which sends off the medulla spinalis through the spine. GG, That part of the os occipitis which is placed above (HH) the transverse processes of the first cervical vertebra. II, &c., The seven cervical vertebræ, with their intermediate cartilages. KK, &c., The twelve dorsal vertebræ, with their intermediate cartilages. LL, &c., The five lumbar vertebræ, with their intermediate cartilages. M, The os sacrum. N, The os coccygis.

ANATOMY

Plate XII

Fig. 1

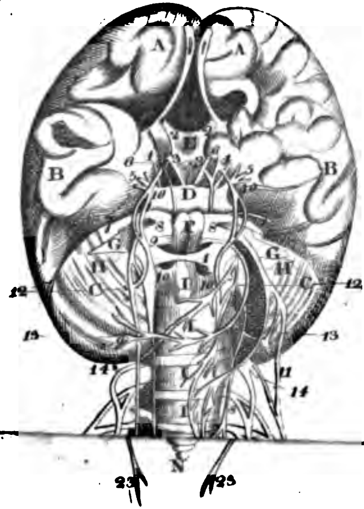

Fig. 2

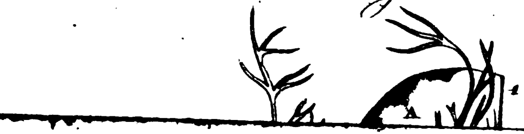

Fig. 3

Scot. Sculp.

Nerves.—1 1, The first pair of nerves, named *olfactory*, which go to the nose. 2 2, The second pair named *optic*, which goes to form the tunica retina of the eye. 3 3, The third pair, named *motor oculi*; it supplies most of the muscles of the eye-ball. 4 4, The fourth pair, named *pathetic*,—which is wholly spent upon the musculus trochlearis of the eye. 5 5, The fifth pair divides into three branches. The first, named *ophthalmic*, goes to the orbit, supplies the lachrymal gland, and sends branches out to the forehead and nose. The second, named *superior maxillary*, supplies the teeth of the upper jaw, and some of the muscles of the lips. The third, named *inferior maxillary*, is spent upon the muscles and teeth of the lower jaw, tongue, and muscles of the lips. 6. 6, The sixth pair, which, after sending off the beginning of the intercostal or great sympathetic, is spent upon the abductor oculi. 7 7, The seventh pair, named *auditory*, divides into two branches. The largest, named *portio mollis*, is spent upon the internal ear. The smallest, *portio dura*, joins to the fifth pair within the internal ear by a reflected branch from the second of the fifth, and within the tympanum, by a branch from the third of the fifth, named *chorda tympani*. Vid. fig. 3. near B 8 8, &c. The eighth pair, named *par vagum*,—which accompanies the intercostal, and is spent upon the tongue, larynx, pharynx, lungs, and abdominal viscera. 9 9, The ninth pair, which are spent upon the tongue. 10, 10, &c. The intercostal, or great sympathetic, which is seen from the sixth pair to the bottom of the pelvis on each side of the spine, and joining with all the nerves of the spine;—In its progress supplying the heart, and, with the par vagum, the contents of the abdomen and pelvis. 11 11, The accessorius, which is spent upon the sterno-cleido-mastoideus and trapezius muscles. 12 12, The first cervical nerves;—13 13, The second cervical nerves;—both spent upon the muscles that lie on the neck, and teguments of the neck and head. 14, 14, The third cervical nerves, which, after sending off, (15 15, &c.) the phrenic nerves to the diaphragm, supply the muscles and teguments that lie on the side of the neck and top of the shoulder. 16 16, The brachial plexus, formed by the fourth, fifth, sixth, seventh cervicals, and first dorsal nerves; which supply the muscles and teguments of the superior extremity. 17 17, The twelve dorsal, or proper intercostal nerves, which are spent upon the intercostal muscles and some of the large muscles which lie upon the thorax. 18 18. The five lumbar pair of nerves which supply the lumbar and abdominal muscles, and some of the teguments and muscles of the inferior extremity. 19 19, The sacro-sciatic or posterior crural nerve, formed by the two inferior lumbar, and three superior of the os sacrum. This large nerve supplies

the greatest part of the muscles, and teguments of the inferior extremity. 20, The stomachic plexus, formed by the eighth pair. 21, 21, Branches of the solar or cœliac plexus, formed by the eighth pair and intercostals, which supply the stomach and chylopoietic viscera. 22 22, Branches of the superior and inferior mesenteric plexuses, formed by the eighth pair and intercostals, which supply the chylopoietic viscera, with part of the organs of urine and generation. 23 23, Nerves which accompany the spermatic cord. 24 24, The hypogastric plexus, which supplies the organs of urine and generation within the pelvis.

Fig. 2, 3, 4, 5, Show different Views of the Inferior part of the Brain, cut perpendicularly through the Middle,—with the Origin and large Portions of all the Nerves which pass out through the Bones of the Cranium,—and the three first Cervicals.

A, The anterior lobe. B, The lateral lobe of the cerebrum. C, One of the lobes of the cerebellum. D, Tuber annulare, E, Corpus pyramidale, in the middle of the medulla oblongata. F, The corpus olivare, in the side of the medulla oblongata. G, The medulla oblongata. H, The medulla spinalis.

Nerves.—1 2 3 4 5 6 7 8 and 9, Pairs of Nerves. 10 10, Nerves accessorius, which comes from 11, 12, and 13, The three first cervical nerves.

EXPLANATION OF PLATE XIII.

Fig. 1. Shows the Lachrymal Canals, after the Common Teguments and Bones have been cut away.

a, The lachrymal gland. b, The two puncta lachrymalia, from which the two lachrymal canals proceed to c, The lachrymal sac. d, The lachrymal duct. e, Its opening into the nose. f, The caruncula lachrymalis. g, The eye-ball.

Fig. 2. An interior View of the Coats and Humours of the Eye.

a a a a, The tunica sclerotica cut in four angles, and turned back. b b b b, The tunica choroides adhering to the inside of the sclerotica and the ciliary vessels are seen passing over— c c, The retina which covers the vitreous humour. d d, The ciliary processes which were continued from the choroid coat. e e, The iris. f, The pupil.

Fig. 3. Shows the Optic Nerves, and Muscles of the Eye.

a a, The two optic nerves before they meet. b, The two

ANATOMY **Plate XIII.**

Fig. 3

Fig. 1

Fig. 2

Fig. 6

optic nerves conjoined. c, The right optic nerve. d, Musculus attollens palpebræ superioris. e, Attollens oculi. f, Abductor. gg, Obliquus superior, or trochlearis. h, Abductor, i, The eye-ball.

FIG. 4. Shows the Eye-ball with its Muscles.

a, The optic nerve. b, Musculus trochlearis. c, Part of the os frontis, to which the trochlea or pulley is fixed through which,—d, The tendons of the trochlearis pass. e, Attollens oculi. f, Adductor oculi. g, Abductor oculi. h, Obliquus inferior. i, Part of the superior maxillary bone to which it is fixed. k, The eye-ball.

FIG. 5. Represents the Nerves and Muscles of the Right Eye, after part of the Bones of the orbit have been cut away.

A, The eye-ball. B, The lachrymal gland. C. Musculus abductor oculi. D, Attollens. E, Levator palpebræ superioris. F, Depressor oculi. G, Abductor. H, Obliquus superior, with its pulley. I, Its insertion into the sclerotic coat. K. Part of the obliquus inferior. L, The anterior part of the os frontis, cut. M, The crista galli of the ethmoid bone. N, The posterior part of the sphenoid bone. O, The transverse spinous process of the sphenoid bone. P, The carotid artery, denuded where it passes through the bones. Q, The carotid artery within the cranium. R, The ocular artery.

NERVES.—a a, The optic nerve,—b, The third pair. c, Its joining with a branch of the first branch of the fifth pair, to form l,—The lenticular ganglion, which sends off the ciliary nerves, d. e e, The fourth pair. f, The trunk of the fifth pair. g, The first branch of the fifth pair, named ophthalmic. h, The frontal branch of it. i, Its ciliary branches, along with which the nasal twig is sent to the nose. k, Its branch to the lachrymal gland. l, The lenticular ganglion. m, The second branch of the fifth pair, named superior maxillary. n, The third branch of the fifth pair, named inferior maxillary. o, The sixth pair of nerves—which sends off p, The beginning of the great sympathetic. q, The remainder of the sixth pair, spent on c, The abductor oculi.

FIG. 6. Represents the head of a youth, where the upper part of the cranium is sawed off,—to show the upper part of the brain, covered by the pia mater, the vessels of which are minutely filled with wax.

AA, The cut edges of the upper part of the cranium. B, The two tables and intermediate diploe. BB, The two hemispheres of the cerebrum. CC, The incisure made by the falx,

D, Part of the tentorium cerebello super expansum. E, Part of the falx, which is fixed to the crista galli.

FIG. 7. Represents the parts of the external Ear, with the Parotid Gland and its Duct.

aa, The helex. b, The antihelix. c, The antitragus. d, The tragus. e, The lobe of the ear. f, The cavitas innominata. g, The scapha. h, The concha. ii, The parotid gland. k, A lymphatic gland, which is often found before the tragus. I, The duct of the parotid gland. m, Its opening into the mouth.

FIG. 8. A view of the posterior part of the external Ear, meatus auditorius, tympanum with its small bones and Eustachian tube, of the right side.

a, The back part of the meatus, with the small ceruminous glands. b, The incus. c, Malleus. d, The chorda tympani. e, Membrana tympani. f, The Eustachian tube. g, Its mouth from the fauces.

FIG. 9. Represents the anterior part of the right external Ear, the cavity of the tympanum—its small bones, cochlea, and semicircular canals.

a, The malleus. b, Incus, with its long leg resting upon the stapes. c, Membrana tympani. d, e, The Eustachian tube covered by part of—f f, The musculus circumflexus palati. 1, 2, 3, The three semicircular canals. 4. The vestibule. 5, The cochlea. 6, The portio mollis of the seventh pair of nerves.

FIG. 10. Shows the Muscles which compose the fleshy substance of the Tongue.

a a, The tip of the tongue, with some of the papillæ minimæ. b, The root of the tongue. c, Part of the membrane of the tongue, which covered the epiglottis. dd, Part of the musculus hyo-glossus. e, The lingualis. f, Genio-glossus. gg, Part of the stylo-glossus.